The Journal

OF THE

AMERICAN DENTAL ASSOCIATION

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The Journal of the American Dental Association. Vol. 27, No. 7. Published by the American Dental Association, 212 East Superior Street, Chicago, Ill. Yearly subscription $5.00. Single copy fifty cents. Entered as second-class matter, January 20, 1939, at the postoffice at Chicago, Ill., under the act of August 24, 1912. Published monthly. Copyright, 1940, by the American Dental Association.

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THE JOURNAL
of the
AMERICAN DENTAL ASSOCIATION

Vol. 27 JULY 1940 No. 7

DENTAL HEALTH CAPACITY: ITS EVALUATION AND PREDICTION

By ARTHUR L. JENSEN, D.D.S., Berkeley, Calif.

PRESENT methods of recording dental histories leave much to be desired, especially for evaluating the status of dental health on the basis of its capacity to function throughout life. There are a multiplicity of factors in the make-up of favorable and unfavorable qualities in the dental mechanism. These, further confounded by the phenomenon of individual variation, constitute the complex dental problem. In addition, present concepts and standards are based on the limited experience and fickle memory of the individual dentist. With existing methods, he has, at most, rough descriptions gleaned from meager dental histories on a few hundred cases. Such records are worthless for establishing accurate criteria. As a result, concept and opinion differ so generally and standards of procedure vary so widely that the standing of dentistry as a scientific profession is open to challenge.

What is needed is a quick and accurate means of describing a mouth, as to the various conditions present in it and the level of its well-being and capacity to function. What is needed is a standard means of evaluating all favorable and unfavorable qualities in the dental mechanism on a basis which makes possible their recording and analysis.

These requirements are satisfied by the statistical method used in commerce, banking, marketing, merchandising, insurance, etc., for the recording and evaluation of data. It is used in biology, being known as the biometric method. Becks and Wainwright,[1] of the Division of Dental Medicine of the University of California College of Dentistry, recently presented a description of the technic and use of this method in salivary analysis. They[2] have used it recently to compute the standard values of human saliva in their notable biochemical studies of that problem.

In all fields where it has been ap-

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Read before the Section on Histology, Physiology, Pathology, Bacteriology and Chemistry (Research) at the Eighty-First Annual Session of the American Dental Association, Milwaukee, Wis., July 18, 1939.

plied, the use of the statistical method has made phenomenal accomplishment possible. It makes for the establishment of standard methods of measuring, recording and analyzing a variety of data. The use of these standard methods makes possible the pooling of experience on the part of many participants. Thus there is made possible the rapid accumulation of a large number of case records with the experience of the participants measured through an elapsed time, the analysis of which refutes controversy arising from limited individual experience and establishes definite standards on the basis of quantitative experience. Such a method would be of great value to dentistry. As a matter of fact, it is possible to apply it by evaluating dental health capacity by a quantitative method.

Fig. 1.—Diagnostic roentgenograms.

By dental health capacity is meant the capacity of the dental mechanism to function through life. The evaluation of this capacity is accomplished by using a numerically calibrated measuring stick to grade the losses sustained by the dental mechanism. This means of measuring is essentially a demerit system, which uses six classes to express the range of well-being from the best to the worst. Class 0 represents no loss; Class 5 represents complete loss, and Classes 1, 2, 3 and 4 represent symmetrical divisions of the intervening degree between these two extremes. Following is a code describing the extent of each of these classes.

Class 0. No loss in an excess amount compatible with the elapse of time.

Class 1 (a). A slight degree once active, but now controlled.

(b). A faint degree, not measurable as active (incipient).

Class 2 (a). A slight degree, active.

(b). A further degree, controlled.

Class 3 (a). A further degree, active.

(b). A hazardous degree, controlled.

Class 4 (a). A hazardous degree, active.

(b). A hazardous degree, insecurely controlled.

Class 5. A degree beyond control necessitating loss of the tooth or having already resulted in its loss.

All desirable and undesirable qualities in the dental mechanism are systematically considered for each tooth, and graded according to their severity. The factors here rated include those listed in Table 1.

positive and negative findings are indicated on more than twenty factors which are systematically judged and readily recorded for each tooth and its supporting structure. Each factor recorded is indicated by a code letter (such as C for caries) and the degree of loss to the tooth is expressed by number according to the Class 0 to 5. The final rating of the dental health capacity of each tooth is based on these recordings and expressed similarly by the same numerical scale in Classes 0 to 5.

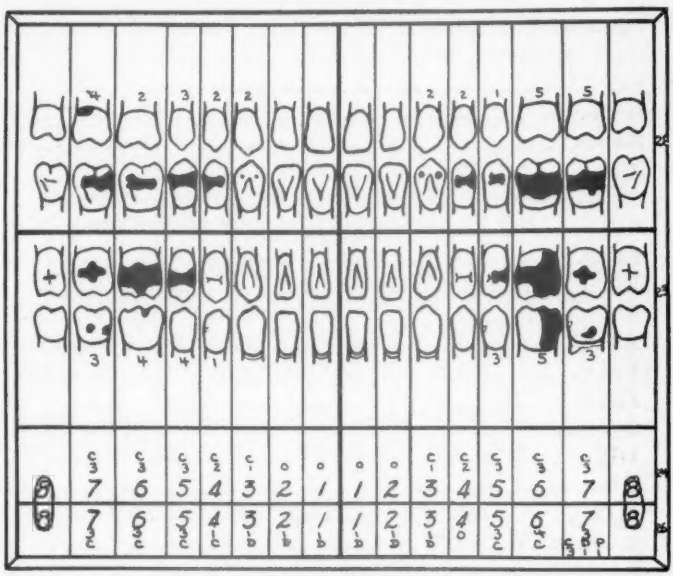

Fig. 2.—Chart for rating dental health capacity.

In rating a case, it is obviously necessary to have authentic and clearly diagnostic roentgenograms. The case is then charted, all conditions found present being indicated diagrammatically. As an example, a roentgenogram is presented followed by the chart and rating of the dental health capacity. (Figs. 1 and 2.)

All positive findings are recorded. Failure to record a factor indicates that no loss has been sustained to date because of such a condition. By this means, both

Thus, the degree of loss of dental health capacity is expressed and recorded in a numerical scale for each tooth in the mouth by estimating and recording the degree of loss sustained by each destructive process which is or has been active. The numerical rating uses five classes to indicate the degree of loss to each tooth and these may be totaled and converted into a fractional expression of the loss of the mouth as a whole. If the evaluation of a particular case is to in-

clude the third molars, obviously thirty-two teeth would form the basis and five times thirty-two, or 160, would form the denominator of the fraction. However, in many persons who do not have third molars in function and may be more accurately considered without them, twenty-eight teeth would be the basis and five times twenty-eight, or 140, would then be the denominator of the fraction. A total of the health capacity ratings of the teeth of a mouth forms the tained to date simply written. Since this is an expression of the amount of lost dental health capacity, it may be converted into an expression of retained dental health capacity by subtracting from 100. This result then represents a percentage expression of the dental health capacity compiled from an estimate made of the local factors in the health capacity of the individual teeth.

Figure 3 shows the conversions in the sample case previously shown.

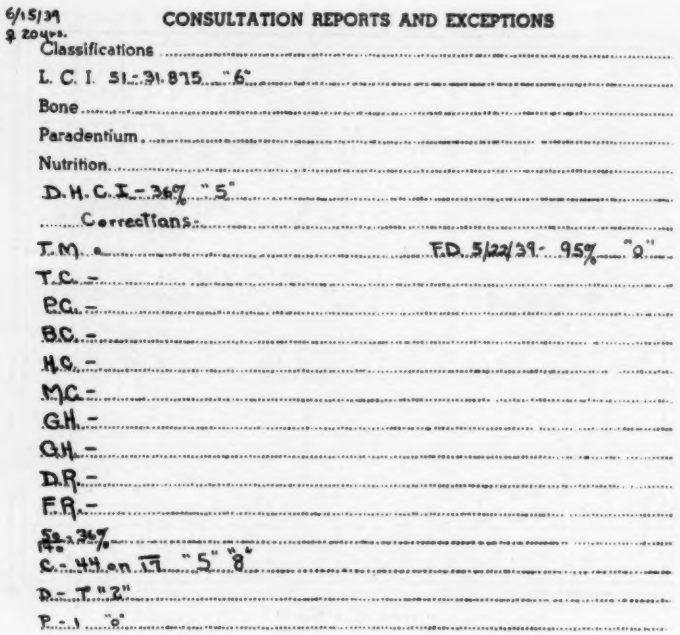
6/15/39
8 zones.
CONSULTATION REPORTS AND EXCEPTIONS
Classifications
L. C. I. 51-31-875 "6"
Bone
Paradentium
Nutrition
D. H. C. I. - 36% "5"
Corrections
T. M. e F.D. 5/22/39 - 95% "0"
T. C. -
P. C. -
B. C. -
H. C. -
M. C. -
G. H. -
G. H. -
D. R. -
F. R. -
140 - 36%
C. - 44 on 17 "5" "8"
D. - T "2"
P. - 1 "0"

Fig. 3.—Conversions in case referred to in Figures 1-2.

numerator for the fraction expressing the loss of dental health capacity sustained.

This can simply be converted into a percentage expression by following conversion tables for fractions of 140 and 160. By this means, the capacity lost by the mouth as a whole can be expressed as a percentage; the amount lost from each destructive process can likewise be totaled, and the formula for losses sus-

Consideration may also be made for general factors in the health capacity of the mouth as a whole. These factors may be estimated as to the hazard that they impose upon dental health and be expressed in percentage and deducted from the dental health capacity previously expressed on the basis of local findings. This will give a final percentage expression of the dental health capacity index corrected for factors of general influence.

These factors of general influence might include the eleven following:

T.M. Teeth missing, and a general estimate of the hazard to the remaining teeth of their absence.

T.C. General tooth condition, a rating of the general hardness and durability of the tooth tissues.

P.C. General paradental condition, a rating of the general health and resistance of the soft tissues.

B.C. General bone condition, a rating of the density as well as any evidence of variation from normal.

H.C. General home care, a rating of the adequacy of the patient's own care of the mouth.

M.R. General maintenance routine, a rating of the adequacy of the dental routine.

G.A. General attitude, a rating of the value that the patient places upon his dental health and the value of maintenance service.

G.H. General health, a rating of the physical well-being that might be significant to dental health.

F.E. Functional efficiency, a rating of the functional relation of teeth as it may affect dental health.

D.R. Dietary routine, a rating of the adequacy of the dietary routine significant to dental health.

D.I. Dental inheritance, a rating of the possible influence of inheritance upon the experience of dental health.

TOTAL		3	27	26	55	56	54	109	103	57	27		
AGE													TOTAL
61 +	9	0	0	0	0	0	0	0	0	0	0		0
51-60	8	0	0	0	0	2	2	4	3	2	2		15
41-50	7	0	0	0	2	3	4	7	10	11	2		39
36-40	6	0	0	1	5	4	6	15	11	6	1		49
31-35	5	0	4	8	10	14	15	32	45	19	10		165
26-30	4	0	3	6	12	13	13	28	25	15	8		123
21-25	3	2	5	4	8	10	8	15	7	2	3		64
16-20	2	1	7	4	9	8	5	6	1	2	1		44
11-15	1	0	8	3	1	2	1	2	1	0	0		18
1-10	0	0	0	0	0	0	0	0	0	0	0		0
		0	1	2	3	4	5	6	7	8	9		
D.H.C.I. %		0-10	11-20	21-25	26-30	31-35	36-40	41-50	51-60	61-70	71+		

Fig. 4.—Chart showing age and dental health capacity distribution.

There are, no doubt, other factors than these in dental health experience. They may be added subsequently. Much study will surely be necessary in order to establish standards for estimating the influence these many factors have on dental health capacity. Possibly, one of the first steps might be an accurate method of recording estimates of these values at a given time; for, with such a method of recording, subsequent rechecks will reveal the degree of error.

The degrees, or classes, 0 to 5 may be defined in due course for each factor. Time and experience, as well as the collection of a larger number of records, will make possible the development of progressively better standards for the discrimination of degree for the various factors. A detailed description of typical and borderline examples of each class for each factor rated, as well as x-ray reproductions and other means of recording such examples, is in the process of development. Such a code and its description may serve as a standard by which ratings can be made and duplicated with a measurable minimum of error for each dentist as well as for groups of dentists. It is to be understood that borderline decisions must frequently be made between one class and another, and when they are disconcerting, it is well to remember that it is something to even recognize them as borderline.

Sufficient information to estimate all factors may not be available on a case at a particular time. However, the dental health capacity index may still be of definite value, for the dated record will indicate the extent of the factors rated. This may seem a laborious procedure, but, as a matter of fact, it is amazingly simple. In our present routine, the assistant charts the case and also provides the roentgenograms. With these available, a case can be evaluated in from five to ten minutes, and again final computations are made by the assistant. Verifications can be made at later intervals in even less time, if intervening records are properly kept. Confirmations of these estimates and recordings should be made at regular intervals of possibly a year. These rechecks will probably be at variance with the originals. Two reasons are offered for these variances. First, of course, is the possibility that the dental health capacity of the case has changed in the interval. In this instance, an experience index of the change is available, together with a descriptive record of what factors changed in what teeth and to what degree. The second reason for variances between original and subsequent estimates and recordings is the human equation. This variable, fortunately, under such a system of recording, is measurable. With authentic and entirely diagnostic roentgenograms and descriptive recordings of conditions available from the time of a previous rating, and with the estimated rating of each factor active for each tooth recorded for both ratings, the particular points of variance can quickly be determined. Thus, the specific error in judgment can readily be observed and corrected.

Five hundred practical cases have been charted and the dental health capacity has been evaluated by the method described and according to the example

TABLE 1.—FACTORS IN LOSS OF DENTAL HEALTH CAPACITY

Tooth Structure Losses	Soft Tissue Losses	Bone Tissue Losses
(C) Caries	(D) Detachment	(HA) Horizontal atrophy
(E) Erosion	(P) Pocket	(V) Vertical atrophy
(W) Wear	(I) Inflammation	(O) Osteoporosis
(A) Accident	(H) Hypertrophy	(BP) Other pathologic lesions
	(PL) Other pathologic lesions	

Functional Losses	Morphology
(M) Malposition	(MT) Tooth form
(FA) Adjacent teeth missing	(MC) Crown form
(FO) Opposing teeth missing	(MP) Pulp form
(OV) Overstress	(MD) Developmental excellence

previously cited. The presentation of this material is not made with any idea that such a limited number of cases is adequate for drawing any significant conclusions, but rather for the purpose of showing what can be done by this method, in the hope that it may provoke the interest of other observers to the extent of using the method and contributing to the pool of evaluated cases.

Figure 4 is a scatter grid chart showing age and dental health capacity distribution.

In this study, the following information was recorded on punch cards for the 500 cases reported: group number; dentist number; case number; age; sex; date (month and year); dental health capacity index and the amount lost through each of the twenty-one factors rated in its analysis (as previously listed); life caries index; primary caries frequency index; secondary caries frequency index; maintenance pattern; number of appointments for the year; dentist's time; hygienist's time; systemic factors; dietary factors; inheritance factors; home care; adequacy of maintenance routine; roentgenogram rating, and economic status.

TABLE 2.—DATA ON TWELVE CASES GROUPED ACCORDING TO AGE AND DENTAL HEALTH CAPACITY

						Structural Loss	Soft Tissue Loss							Bone Loss		Function	Morphology		Caries Index								
Group Number / Dentist Number	Case Number	Age	Sex	Month	Year	D.H.C.I.	Number of Teeth	Erosion	Wear	Accident	Detachment	Pocket	Inflammation	Hypertrophy	Deposits	Pathology	Vertical Atrophy	Horizontal Atrophy	Osteoporosis	Pathology	Malposition	Adjacent	Opposing	Abutment	Stress	Crown	Root	Pulp	Excellence	L.C.I.	P.C.F.I.	S.C.F.I.	Maintenance Pattern	No. of Appointments	Dentist Time	Hygienist Time	X-Ray Adequacy
	263	50	1–0	8	89		1	0	0	0	0	0	0	0	0				5						1			0	8	0	0	1	4	1	4	8
	269	51	2–9	8	89		0	0	0	3	0	0	0	0	0		3		5						0			0	8	1	1	1	4	2	5	7
	267	51	1–0	7	84		0	0	0	9	0	0	0	0	0		9		0						0			0	6	1	0	4	6	5	5	1
	270	51	4–0	7	89		0	0	0	2	0	0	0	0	0				2						0			0	8	1	0	1	5	1	5	8
	271	51	8–8	7	88		0	0	0	0	0	0	0	0	0				0						0			0	6	0	0	1	4	1	4	8
	274	51	3–9	7	68		0	0	0	2	0	0	0	0	0				4						0			0	5	0	1	1	4	3	3	8
	273	51	3–9	7	89		0	0	0	2	0	0	0	0	0		2		0						0			0	8	1	0	2	5	6	1	1
	282	51	4–9	5	68		0	0	0	4	0	0	0	0	0				0						0			0	4	1	1	1	4	2	4	8
	284	50	9–8	8	89		0	0	0	5	0	0	0	0	0				6						0			0	8	1	0	2	4	5	3	7
	285	51	8–6	6	78		0	0	0	0	0	0	0	0	0				2						0			0	6	1	0	2	4	3	5	5
	299	51	3–9	6	58		0	0	0	5	0	0	0	0	0				0						0			0	5	0	0	1	3	0	5	8
	335	51	1–9	3	21		0	0	0	7	0	0	0	0	0				0						0			0	2	1	0	1	3	0	4	8

Table 2 is an example of the tabulation report on twelve cases of the 500 grouped according to age and dental health capacity.

By this method, sortings can simply be made for any data expressed on the card, and quantitative studies on any information so listed thus be made possible.

The collection of this type of data obviously brings up the problem of sorting into groups. If this is undertaken manually, the process is hopelessly slow and inaccurate. However, mechanical speed sorting catalyzes speed, efficiency and economy, opening unprecedented possibilities for quantitative studies. By this method, data expressed either numerically or by code can be transferred to a punch card and sorting accomplished mechanically with amazing speed and unerring accuracy.

The expression of the number of data referred to above, on the punch card, takes only forty-nine of the eighty columns available on the card. Thus, considerably more data can be included if other factors are found significant or if any of these are found to need breaking up into component factors.

Such a quantitative method of estimating and recording the dental health capacity index offers the profession an entirely new vehicle for the expression of dental findings, which could have a far-reaching effect of cumulative value. It makes possible the detailed description of cases, and thus the accumulation of their histories with their variable factors expressed in significant degrees and recorded in a simple form conducive to analysis and interpretation. It is applicable to clinical investigation and to private practice as well. For the clinical investigator, it allows the comprehensive analysis of cases by a standardized method systematically considering all factors and evaluating them individually and collectively for each tooth and for the mouth as a whole. Thus, regardless of what clinical problems were under investigation, each case would be comprehensively analyzed by the same method, which would allow a collective study of all cases observed in that investigation or in any other where similar methods were employed.

It is applicable to the private practice of dentistry and of value to the single or individual case as well as to group study. To the individual case, such a method would contribute thoroughness as to the diagnosis and facility in the treatment planning. Furthermore, it would make possible a far-sighted program for sustained dental health maintenance with a constant check on individual variation. It would provide an up-to-date record of the capacity remaining at a given time, and rechecks as time elapses would give a measure of the rapidity of loss sustained for a given interval and thus make possible the prediction of dental expectancy.

The accuracy of such interpretations for the individual case may be greatly enhanced by group study. Yet little is gained by comparing any case or its experience with that of the field, since the field represents so wide a range of variation from the best to the worst and from the young to the old. But if age groups and various graded capacity levels are segregated and further divided into smaller groups in which similar degrees of loss have been sustained by the same destructive processes, comparative studies are significant. To compare a case and its subsequent experience record with a group of other cases, similar to if not identical with it, which, in a similar period of time, had experienced comparable degrees of loss through the same destructive process would be of significance.

This would serve to establish standardized patterns of routine attention adequate to the maintenance of dental health for the various brackets of age group and capacity level. With numbers of cases in the various brackets following the standardized routine for their bracket, limits of favorable experience in dental health or a dental health experience index could be developed for each bracket. This would safeguard dental expectance; for as long as the experience of an individual person fell within the favorable limits of his or her bracket, he could go on his way, confident that the procedure he was following in care and attention was adequate to date, confident further that in the event his experience for any reason should vary from this pattern at any subsequent time, by this procedure of check-up that variation could be recognized in time for him to take cognizance; for if he is really following the pattern of procedure which has been adequate for a high percentage of his bracket, this variation would indicate that his capacity

from some other point of view was no longer what it had been. If the variations were at all severe, it would surely suggest a check-up of any factors which might be responsible. These would include factors of general systemic nature in dental health. In the examination of these factors, a standardization of procedure would be encouraged to include all factors in other similar cases which had proved to be of significance.

Dental caries represents one of the outstanding destructive processes complicating the problem of dental health maintenance. Its prevention has of course been a baffling study, and many attempts to solve the problem have been made, most hopeful of which at the present time may be the bacteriologic studies of *Lactobacillus acidophilus* in saliva and control by diet. Whether the problem was dental caries or whether the attempt at correction were through the bacterial approach or what not, the continued maintenance of the dental health experience index would indicate the adequacy of the corrective procedure; for if, in the next period of time, the dental health experience showed a return within the favorable experience limits of the particular bracket, the problem, practically speaking, would be solved. Otherwise, the search for other factors in the loss should be continued or at least the maintenance routine be adjusted to the situation.

The thought occurs that a lifetime of experience, so recorded, would be necessary to write a formula or prove a pattern. This is not true. If available, such histories, though of value and certainly of great interest, would not be adequate for current use. Obviously, the living conditions, dietary, personal care and particularly the excellence of dental attention of several years ago have changed so as to make the experience history of that time not applicable to the current problem. Similarly, environmental conditions in the next several years will probably change, as will the level of adequacy and excellence of dental attention to make present histories insufficient for the problem then. What is needed is a composite life span that is entirely current. This can be supplied by quantitative study, by segregating large numbers of cases into brackets of age groups and dental health capacity levels.

SUMMARY

The application of a standard measuring stick, expressing numerically graded losses sustained by the dental mechanism, allows the evaluation of the dental health capacity and thus makes possible the application of a quantitative method to the complex dental problem. Through this method, a standard procedure may be set up for systematically considering and evaluating all factors known to date in the make-up of desirable and undesirable qualities in the dental mechanism. A comprehensive analysis and recording of cases on a basis which makes possible statistical analysis may be accomplished. This method of grading can be so standardized that different observers can use it and come within a small percentage of variation in their ratings. This allows pooling of cases so evaluated and subsequent experiences. Experts in the field of statistical analysis estimate variously that, with the accumulation of from 25,000 to 50,000 cases, variation will be reduced to a workable minimum. On this basis, a relatively small percentage of the dentists of the nation could write the formula for dental expectancy by pooling their experience. Thus such questions as these could be answered: What constitutes an adequate procedure for the maintenance of mouth health for various graded brackets of age group and dental health capacity level? Also, what is the experience on any other pattern of procedure? Within what limits of experience can persons in particular brackets of age group and dental health capacity level be said to have a favorable dental ex-

pectancy? When do variations occur and what is responsible? These and many related questions can be answered by a quantitative method through group experience on such an impersonal basis as to dispel prejudice and bias, minimize error and assure such a degree of accuracy as to be impelling.

Such a program would standardize dental health maintenance procedure and standardize the level of operative excellence and judgment on the basis of comparative measured experience. It would be a vital influence in any program of dental health education in that it would explain the dental problem to the public in terms they understand; namely, in numbers. How good are one's teeth in percentage? How much time will it take to keep them in order in hours and minutes per year? What will it cost in dollars and cents? Following a prescribed program, what are his chances? What are his alternatives? He is an individual, but there are many more like him from whose experience much can be learned.

A vastly larger number of people could afford to maintain an adequate dental health program and would if that program could be prescribed to their individual needs with some assurance of a favorable dental expectancy. Especially would that be appealing if the less favorable experience of compromise procedure were shown in the experience of comparable cases. And for the benevolent agency that is considering any program of dental attention for the indigent poor or for any social approach to the dental problem, certainly such a method would be invaluable in computing their problem and thus be a potent influence in upholding standards in dentistry.

CONCLUSION

The quantitative method can be applied to dentistry through the evaluation of the dental health capacity index.

This evaluation can be accomplished and recorded by numerically expressing the degree of loss sustained by each tooth in the mouth through each destructive process.

The method of rating can be so standardized as to allow trained observers to approach a workable minimum of variation in their ratings.

This consistency of rating facilitates the establishment of a standard comprehensive method of analysis and makes possible critical observation and recording of experience.

Such standard recordings allow the pooling of experience on the part of many observers.

Mechanical sorting, to which such data numerically expressed are ideally suited, catalyzes speed, efficiency and economy so as to open unprecedented possibilities for quantitative studies.

By such a quantitative method, data can be collected on a sufficient number of cases to establish standard patterns of attention adequate for the maintenance of dental health for various brackets of age and dental health capacity level.

Within standard patterns of attention, experience can be observed and recorded to the end that, for each bracket, limits may be set within which dental expectancy can be predicted with workable accuracy.

Such quantitative studies could be a constructive influence in clinical investigation and of practical value in private practice, and would certainly be a stabilizing influence in any social approach that might be made to the complex dental problem.

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THE SOLVENT ACTION OF VARIOUS SUBSTANCES ON TEETH: A QUANTITATIVE DETERMINATION

By JOHN W. TRASK, M.D.; EDWIN E. ZIEGLER, M.D., and EDWARD C. MALOOF, D.M.D., Boston, Mass.

DENTAL CARIES is a common disease of man. A carious tooth, in itself, is considered to be a minor affliction; neglected, it may become of serious importance. The ultimate results of neglected dental disease in morbidity and mortality has not been, and probably cannot be, accurately determined. They are, however, conceded by all to be of considerable importance.

In recent years, there have been important advances in the study of dental caries, but, up to now, the majority of studies have been purely clinical. In general, they have not yielded results convincing to all authorities or of material help in reducing materially the incidence of dental caries in the population.

It is believed that an attack on dental caries may possibly be made to advantage with the assistance of the laboratory.

There are, no doubt, multiple factors in the etiology of dental caries. A useful division of these factors is proposed. It is believed that they may be divided advantageously into extrinsic and intrinsic factors. The extrinsic factors would consist of the direct effect of substances present in or taken into the mouth, such as saliva, bacteria and their products, food and drink. The intrinsic factors would be those usually called metabolic.

The intrinsic factors have been extensively studied in recent years. The studies, which have been concerned with the intake of vitamines, especially vitamines C and D, and the intake of mineral salts, especially calcium and phosphorus, have been highly complex, involving not only the amounts ingested, but also the efficiency of digestion and absorption and the action of these substances when they reach the blood stream and tissues. There are other recognized intrinsic factors, such as race, heredity,[1] maternal nutrition and the influence of the endocrine glands.

The extrinsic factors may be listed as follows: dentifrices, food and drink, the chemical factors of the saliva and the products of the bacterial flora. The effects of physical agents must also be added to this list: heat and cold, mechanical defects and trauma. These physical factors are fairly well understood.

Which group of factors, extrinsic or intrinsic, is the more important in the causation of dental caries it is probably not possible to say at the present time. It is claimed by most dental authorities that unerupted teeth never decay. It would seem that extrinsic factors, if not the more important, are at least necessary for the production of caries.

Saliva, food, drinks and dentifrices come in direct contact with the teeth, and, for this reason, it is believed that the direct effects of these substances on the teeth should be studied carefully. Micro-organisms and their products also affect the teeth by direct contact.

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A summary of the possible etiologic factors in dental caries, as proposed, is given in outline form as follows:

ETIOLOGY OF DENTAL CARIES

(A) Extrinsic factors.
- Dentifrices.
- Food and drink.
- Saliva.
- Bacterial flora.
- Trauma.
- Temperature.

(B) Intrinsic or metabolic factors.
- Diet.
  - Mineral salts.
  - Vitamines.
  - Other diet factors.
- Digestion.
- Absorption.
- Assimilation.
- Infection.
- Race.
- Heredity.
- Maternal nutrition.
- Endocrine influences.
- Age.

There seems to be among dentists a firm belief, based on long experience, that acids in general are harmful to teeth, causing decalcification and thus paving the way for decay, the acid most frequently mentioned in this connection being lactic acid. The fermentation of carbohydrates in the mouth by *Lactobacillus acidophilus,* producing lactic acid, is generally believed today to be the chief cause of caries.

The chemoparasitic theory of tooth decay was first proposed by Miller,[2] in 1890. It has apparently been substantiated in large measure by recent workers.[4] A close correlation between the incidence of dental caries and the number of *Lactobacillus acidophilus* organisms in the mouth has been found.[5]

Oral hygiene, today, is based on proper diet and mouth cleanliness. Most authorities recommend that the mouth be kept clean by brushing the teeth. In addition, they advise a low carbohydrate diet, usually mentioning candy specifically.[6]

West and Judy[7] have shown that solutions made of hard candies such as lime drops, lemon drops and orange drops have a decided decalcifying action on teeth. These fruit-flavored hard candies usually contain citric acid and some may contain tartaric acid. Miller and Newman[8] present cases of advanced dental decalcification due to using hard candies and excessive amounts of citrous fruits.

It is believed that many substances used as food can cause decalcification of teeth directly. The above-mentioned authors have demonstrated that foods containing citric acid will do so. It is highly probable that foods containing similar acids, such as acetic, lactic, tartaric, benzoic, malic and oxalic, will also cause decalcification of teeth. Experimental evidence of this is presented.

A start has been made in studying quantitatively the direct effects of acids and various other substances on the teeth. Chemically pure compounds and other simple substances commonly present in the mouth or in food and drink have been studied to determine their direct effects.

So far as it has been possible to ascertain, this is the first attempt to evaluate directly and quantitatively the effects of various substances on the teeth. Most of the substances used were of chemically pure (C.P.) quality, conforming to the American Chemical Society (A.C.S.) specifications. A few were products in which a C.P. quality was not desired, for obvious reasons.

All the substances used were prepared in aqueous solution and were filtered when necessary. Unless otherwise noted, all the solutions used were made up to a tenth normal or to a tenth molecular concentration.

The purpose of the experiments was to determine the relative solvent action on teeth, under standard conditions, of solutions of various substances when these substances were dissolved in comparable concentrations.

The method of the experiments was as follows: Whole non-carious teeth were scrubbed with soap and water immediately after extraction. They were then rinsed in distilled water, air dried and cracked into small pieces with a hammer. The fragments of several teeth were pooled in clean capped test tubes.

For each experiment, there were selected at random ten pieces of tooth, the pieces averaging about the size of a grain of wheat. These pieces of tooth were then accurately weighed on an analytic balance and placed in a small glass cup, which was then placed in the bottom of the syringe barrel in the apparatus. (Fig. 2.)

The solution was then allowed to flow slowly through the apparatus from the Erlenmeyer flask, thus constantly, but slowly replacing the solution about the pieces of tooth, without mechanical agitation of any kind. In every experiment, the pieces of tooth were allowed to remain in the apparatus for exactly five days. They were then removed, washed in distilled water and air dried on blotting paper under a beaker at room conditions for twenty-four hours.

The pieces of tooth were then re-

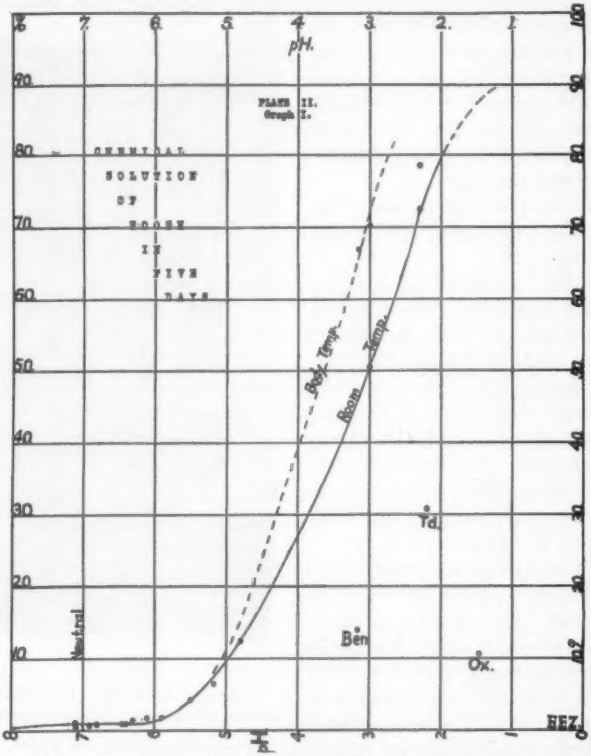


Fig. 1.—Graph showing chemical solution of tooth in five days.

weighed and the percentage of loss in weight calculated.

As the solution dripped from the stopcock at the bottom of the apparatus, air was allowed to enter the tube leading into the inverted Erlenmeyer flask above. This allowed more of the solution to flow from the flask into the syringe barrel,

thus keeping the solution about the pieces of tooth in the syringe barrel at constant volume.

The rate at which the solution dropped from the stopcock was so regulated that from 400 to 600 cc. went through the apparatus in five days.

In each instance, 1 liter of solution was prepared, about 970 cc. of it being placed in the apparatus and the remainder used for pH determinations.

All pH determinations were made with the laboratory model of the Beckman pH meter. At least three and frequently four or five fractions of the solution were tested in the pH meter. The final reading was that made on the last fraction of solution used at the point where repeated readings remained constant.

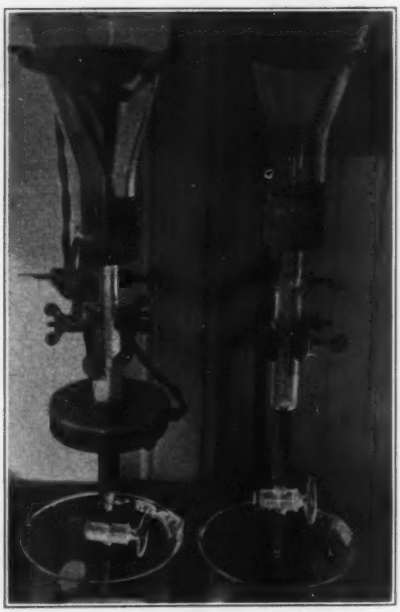
These studies have been made by means of a new improvised and simple apparatus. (Fig. 2, A.)

The apparatus consists of an ordinary iron laboratory ring stand having a base and an upright rod. At about the middle of the upright, a ring support is fastened. On this ring support, a microscope warm stage is placed. The latter, a familiar item in clinical laboratories, is electrically heated and contains an adjustable thermostat. The temperature of the warm stage can be regulated to a desired point and maintained at that point.

There is a hole through the center of the warm stage which is about three-fourths inch in diameter. The barrel of a 10-cc. glass syringe is selected, which fits snugly in this hole so that the bottom of the syringe barrel is flush with the bottom surface of the warm stage. The syringe barrel is secured in this position by an adjustable buret clamp fastened to the upright by another clamp. A glass cup, about three-eighths inch deep, holding the fragments of tooth to be studied, is placed in the bottom of the syringe barrel.

A glass stopcock is attached to the hub of the syringe barrel by means of a short piece of rubber tubing. The stopcock can be regulated to obtain the desired rate of flow of the solution used in any particular experiment.

By means of a ring support, 4 inches outside diameter, a 1-liter Erlenmeyer flask is suspended above the syringe barrel in an inverted position. The mouth of the flask is closed by a cork, previously boiled in paraffin to make it chemically inert. Through a hole in the center of the cork is a piece of straight glass tubing, having an outside diameter of about one-half inch and a length of about 4 inches. The glass tube protrudes into the flask about one-half inch beyond the cork. The height of the flask is so adjusted that the bottom of the glass tube extends into the barrel of the syringe to the 10 cc. mark. This allows the solution in the syringe to have a constant volume of 10 cc., including the glass cup and tooth fragments.



A B

Fig. 2.—Apparatus for testing the solvent action of various substances on the tooth structure.

The solution to be used is placed in the flask. The cork with the glass tube is inserted in the mouth of the flask. The flask is then inverted, resting in the ring support with the tube projecting into the syringe barrel.

The stopcock used with this apparatus was adjusted so that about 2 drops of fluid per minute would flow through. In the average experiment, this rate of flow would amount to about 400 to 600 cc. in the five-day period, adopted as standard for the experiments.

A beaker was placed beneath the stopcock on the base of the ring stand to catch the dripping solution.

If a large incubator or an incubator room were available, the entire apparatus could be placed in it. This would eliminate the necessity for the microscope warm stage. However, it was considered desirable to have the apparatus on the laboratory bench where it could be readily observed several times a day. This made it easy to time the interval between drops and to regulate the stopcock when this was found necessary. Regulation of the stopcock was accomplished by tap-

SOLUTION OF TOOTH IN FIVE DAYS BY VARIOUS COMMON SUBSTANCES

Substance	Concentration	pH	Tooth Dissolved Per Cent	Remarks††
Citric acid	N/10	2.3	78.8	
Phosphoric acid	N/10	1.8	77.7	
Lactic acid	N/10	2.3	72.6	
Acetic acid	N/10 (0.6%)	3.0	70.3	Body temperature
Acetic acid	1%	...	69.0	
Acetic acid	N/10 (0.6%)	3.0	50.5	
Benzoic acid	Sat. sol.†	...	67.0	Body temperature
Benzoic acid	Sat. sol.	3.17	13.9	
Tartaric acid	N/10	2.2	30.8	
Oxalic acid	N/10	1.47	10.6	
Boric acid	M/10	...	6.4	
Boric acid	M/10	5.17	4.1	
"Soda water" (CO_2)	?	4.8	12.2	Body temperature
Sodium carbonate	N/10	11.1	0.3	
Ammonium hydroxide	N/10	11.27	0.9	
Ammonium hydroxide	N/10	11.27	1.1	Body temperature
Calcium chloride	N/10	6.4	0.9	
Sodium chloride	0.85%*	6.8	6.0	(No thymol)
Sodium chloride	0.85%	6.1	1.7	(With thymol)
Distilled water		6.3	1.4	
Cold tap water		6.9	0.9	
Hot tap water		7.15	0.8	
Hot tap water		7.2	0.4	(With thymol)
Dextrose	M/10	...	2.5	(No thymol)
Dextrose	M/10*	7.2	1.0	(With thymol)
Sucrose	M/10	...	0.8	
Sucrose	M/10*	7.13	0.6	
Sucrose	M/10*	7.1	0.2	Body temperature (with thymol)
Light brown sugar	M/10*	6.44	0.9	(With thymol)
Dark brown sugar	M/10*	5.85	1.7	(With thymol)
Raw sugar	M/10*	7.2	0.0	(With thymol)
Lactose	M/10	6.3	7.0	(No thymol)
Lactose	M/10*	7.1	1.2	(With thymol)
Starch, soluble	Sat. sol.	...	1.0	(No thymol)

†Sat. sol.=saturated solution; Solutions made in distilled water unless otherwise indicated. Those made with hot tap water marked with an asterisk.

††Room temperature in all cases except as indicated.

ping on the handle with the back of a scalpel, and thus increasing or retarding the rate of the drops.

A similar apparatus without a warm stage was used to study the effect of solutions on teeth at room temperature.

In the apparatus first described, it was found necessary to put a small thermometer in the syringe barrel, resting in the glass cup in order to determine the actual temperature of the solution about the tooth. It was also found that a small thermometer strapped to the outside of the syringe barrel with adhesive tape as shown in Figure 2, A worked satisfactorily. The thermostat of the warm stage was then regulated so that the solution in the syringe barrel ranged from 95° to 100° F. (35 to 37.78° C.). This range of temperature is probably not so great as the usual range of temperature within the mouth. The mouth and teeth are warmed by hot foods, and they are cooled by the air in talking and by the eating of cold foods. The small thermometer furnished with the warm stage was used because of its convenient size. It is calibrated to the Fahrenheit scale.

The advantages of this method for studying the solvent action of various substances on teeth are many. Difficult, laborious and not too accurate chemical determinations for calcium are avoided. The loss in tooth substance is determined directly and gravimetrically.

The solvent action of the solution on the tooth is determined at approximately its normal temperature or at room temperature, as desired. The tooth fragments are not altered chemically because they are not sterilized by heat or chemicals.

As there is no mechanical action of the solution around the fragments of tooth, the results are known to be entirely from chemical and solvent action.

The solution is slowly and constantly replaced so that it cannot become saturated with calcium salts from the fragments of tooth. This prevents the attainment of a solubility end point previous to the termination of the experiment. The large volume of solution used in relation to the amount of tooth also tends to prevent a false end point of solvent action. The tooth used, being in ten small fragments, offers a fairly large and uniform amount of surface action.

The fragments of tooth consisted of both enamel and dentin. On first thought, it might be held that the enamel is the most important substance to use. However, the normal enamel frequently has natural cracks or fissures that make the dentin directly subject to attack by substances coming in contact with the tooth. Dental caries also involves the dentin more than it does the enamel.

It is difficult to separate enamel from dentin. This can be accomplished, however, and it may be advisable to repeat some of these experiments, using only dentin and then only enamel. A line of cleavage between dentin and enamel can be produced by heat, drying, etc. However, it is believed that heat or other means might alter the crystalline structure and the organic material of the tooth.

Methods to separate dentin from enamel in the pulverized state are available,[9] but it would be difficult to use powdered tooth in such experiments as these. Some powder would undoubtedly be lost by becoming suspended in the solution.

The solutions used, with a few exceptions, were tenth molecular or tenth normal concentrations. This provides a basis for direct comparison of the solvent action of the substances studied on teeth. Others[7] have used percentage solutions of various strengths in studying acidified candies. This method does not permit comparison of the action of one solution with that of another. However, when the composition and molecular weights of a complex substance used are unknown, it

may be necessary to resort to percentage solutions.

The results of the experiments are summarized in the accompanying table. Each line in the table represents a separate experiment, as numbered. The experiments have been grouped for convenience in the following classes, according to the substances studied: acids, alkalis, salts, waters and carbohydrates.

The acids at the top of the table, namely citric, phosphoric, lactic, acetic, benzoic, tartaric, oxalic and carbonic (CO_2), had the most marked effect in dissolving the tooth. The alkalis show no significant solvent action on tooth. The waters dissolved insignificant amounts of tooth. Distilled water dissolved more tooth than did tap water. This is attributed to its lower pH, due to carbon dioxide in solution, absorbed from the air.

The sugars (preserved with thymol 1:1,000) dissolved practically no tooth substance. When the sugars contained no thymol for a preservative, there sometimes occurred some fungus or bacterial growth, with resulting increase in solvent action.

The amount of tooth dissolved increased rapidly with a drop in the pH, as shown by the graph (Fig. 1.). The amount of tooth dissolved was greater at body temperature than at room temperature in the lower (more acid) pH range. In the range from pH 5 to 7, there was no appreciable difference in the results of experiments which were identical except for temperature.

Bacterial or fungus growth which occurred in sugars or even in a physiologic sodium chloride solution caused a small increase in the amount of tooth dissolved, as shown in experiments 18 and 32 in the table.

As will be noted in the table and the graph (Fig. 1), oxalic acid and tartaric acid did not dissolve as much tooth as one would expect in view of their low pH values. This is explained by the fact that a white chalky layer of insoluble crystals was formed on the surface of the tooth fragments. This protected the fragments from further exposure to the acids. Constant agitation in these experiments would no doubt show a greatly increased amount of dissolved tooth.

Benzoic acid at room temperature is not soluble to the extent of one-tenth normal, and this probably accounts for the small amount of tooth dissolved. It will be noted, however, that benzoic acid is much more soluble at body temperature, and, at this temperature, the amount of tooth dissolved conformed to that expected from the curve in the graph. (Fig. 1.)

COMMENT

This work supports the generally accepted theory that lactic acid causes demineralization of teeth. Lactic acid may be produced in the mouth by bacterial decomposition of carbohydrates or it may be taken into the mouth in the form of sour milk or prepared lactic acid milks, such as acidophilus milk. The acid milks may also seed the mouth with *Lactobacillus acidophilus*. This work certainly supports the doctrine that the mouth and teeth should be kept clean, at least those of people who eat carbohydrate foods.

It may be doubted whether bacterial action in the mouth can produce so much acid as is taken into the mouth in the form of acid foods. It is suggested that certain acid foods, commonly used, may play the dominant rôle in decalcification of teeth. A piece of pickled cucumber, between two teeth, with a pH of 2.7, as determined by Bridges and Mattice,[10] would certainly tend to decalcify the adjacent teeth. These authors have published more than 2,000 estimations of the pH of representative foods. From their work, it is noted that more than fifty-six different items of food and drink fall into the pH range between 2.05 and 4.00. This work of Bridges and Mattice is outstanding. It is highly recommended to any one interested in the subject. It is

noted that most of the foods with an unusually low pH are fruits and berries. Of course, all pickled foods made with vinegar, including certain salad dressings, have a low pH. Certain popular drinks are also quite acid in reaction.

It may be worth pointing out that these types of food and drink which are excessively acid are not used by the primitive tribes that have a low incidence of dental caries.[11] Neither are they used in general by any animals. Civilized peoples are too well supplied with a tremendous number of different foods, many of which are probably non-essential and some perhaps undesirable. In contrast, most primitive peoples have available only a small number of food items. Further scientific study of diet and foods seems to be indicated to elucidate these problems.

This work proves that starch and sugars do not decalcify teeth, contrary to a widespread belief. However, it is to be expected that any lactic acid formed in the mouth by fermentation of starches and sugars would certainly attack the teeth.

SUMMARY

1. Starches and sugars *per se* do not decalcify teeth, but lactic acid formed from these may do so.

2. Acid foods having a pH of about 4 or below may prove to be the most important factors in dental decalcification.

3. Other acids than lactic found in foods have been shown to cause extensive decalcification of teeth.

4. Many commonly used foods are acid and have a pH of from 4 to 2.05. The effect of their presence on teeth needs further study.

5. The alkalis studied do not demineralize teeth.

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ANATOMIC PRINCIPLES AS APPLIED TO DENTISTRY

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A STUDY of the architectural design of the skull reveals, first, the care Nature took in determining its original plan; secondly, how she modifies this plan to meet the varied requirements of the species, and, thirdly, how, when accident occurs, Nature still further modifies her architectural plan to best serve the individual.

To illustrate briefly the above statement:

A. The architectural design of skulls is fundamentally the same; i.e., there are certain characteristics common to all.

1. There are always two hard parts, the vault and the mandible, that are separated by a weak part, the face bones.

2. The mandible is a completely separate bone which, within limits, is free to move at will and which strikes the skull only through the teeth. It may be likened to a hammer that strikes on an anvil.

3. In all skulls, the upper jaw is immovable and is attached to the skull by columns of bone that pass through the face bones. These columns are modified and changed to support best the particular type of tooth designed for the species. A skull designed to serve the flat columnar teeth of the herbivora would fail to support the sharp-bladed teeth of the carnivora, and neither type would serve the needle-like teeth of the reptiles.

Such is the care Nature took in her plan of the skull that, by modification of the original design, the varied requirements of the species are satisfied. (Fig. 1.)

B. The function of the mouth in herbivorous animals is to grasp food and prepare it for digestion; and so Nature builds a long snout reaching far forward from the eyes, as in the horse. In the carnivora whose mouth serves the same purpose, the long snout persists, as in the dog; but, as soon as the paws assume part of the function of the mouth, the snout commences to recede, as in the cat. In the monkey, uncivilized man and man, the more the hands assume the function of the mouth, the further the snout recedes beneath the skull.

The third part of my statement (C) will evolve later.

I wish to develop my paper with the idea established in our minds that Nature determined the architectural plan of the skull to make the action of the teeth possible, and that any protection that the skull affords delicate parts is for convenience and not of necessity. The brain in many animals occupies what is practically a large cell situated at the back of the skull and frequently there is no bony protection for the eye.

ARCHITECTURE OF THE SKULL

In order to understand the architecture of the skull, it will be necessary to consider the muscles of mastication. The description of these muscles in textbooks is as a rule unsatisfactory and generally untrue.

Muscles Associated with Movements of the Jaws.—Two characteristics of the muscles that move the jaws are: 1. The comparative weakness of the muscles that open the jaws. 2. The extraordinary power of the muscles that close the jaws. It is an interesting fact that jaws can be

kept closed by a very small external force. One has only to observe how easy it is to keep a dog's mouth closed by pressure on the jaws with the fingers. In many instances, the stronger the muscles are that close the jaws, the weaker are the ones that open them.

Most textbooks state that the human jaws are opened by the external pterygoids and the hyoid muscles. In man, it seems likely that the jaws are opened by the external pterygoids, but it is most unlikely that the hyoids play any part in the action, for two reasons:

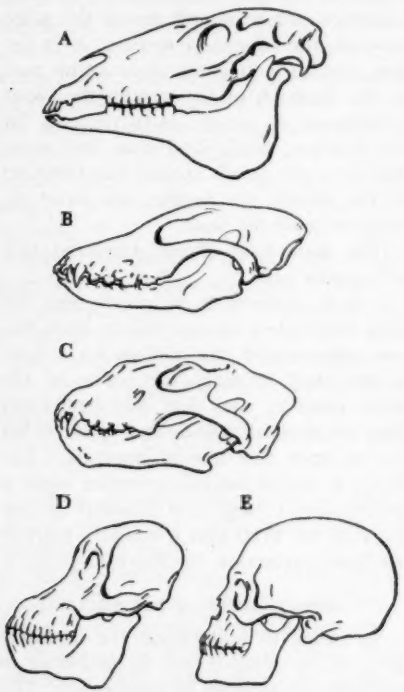


Fig. 1.—Drawings of skulls of various animals, showing similarity of principles of construction; e.g., brain case and mandible always separated by upper face. A, horse; B, dog; C, carnivore; D, ape; E, man.

1. Man can open his mouth against a comparatively great pressure and, at the same time, swallow. It is impossible for the hyoid muscles to take part in two unrelated simultaneous movements; i.e., elevating the hyoid bone and depressing the mandible.

2. According to Hilton's Law, "The same nerve trunks whose branches supply the group of muscles moving a joint furnish also a distribution of nerves to the skin over the insertion of the same muscles, and the interior of the joint receives its nerves from the same source." In seeking an explanation of the significance of the muscles that move a joint, it would be wise to be guided by Hilton's Law. A study of the architecture of skulls, the designs of the teeth and the disposition of the muscles of mastication in animals has led me to believe that the orthodox description of these muscles has been deduced from studying what would appear to happen in the human cadaver rather than what actually takes place in the living animal.

In seeking an explanation among the animals as to what muscles open the jaws, we get little information. In the carnivora, it is apparently impossible for any muscle or combination of muscles of mastication to open the jaws, and in the herbivora and rodents the riddle is just as obscure. An examination of the muscles of mastication in man reveals a large external pterygoid, and, as I have said above, man can open his jaws against a comparatively great pressure. By pulling the condyle forward on the eminentia articularis, it is possible for the external pterygoid to open the jaws in man, but, in the carnivora, the condyle cannot move out of the glenoid fossa. Therefore, either the function of the external pterygoid differs in species or our interpretation of the muscular action is wrong.

Action of Closing the Jaws.—The power available for closing the jaws is enormous. Circus girls have supported the weight of more than six men with their teeth, and it is impossible to assess the power in the jaws of a carnivorous

animal. The dog, a comparatively weak example, can be swung around while holding on to a towel, thus supporting several times his own weight.

All the muscles of mastication take part in the closing of the jaws, and the individual muscles of the group are developed according to the character and the requirements of the animal.

In order to understand the actions of the muscles, it might be wise to consider briefly some architectural characters of skulls.

1. The vault is smooth, rounded and strong. The sutures, as I have noted in a previous essay, are planned to withstand an even pressure from without inward. (Fig. 1.)

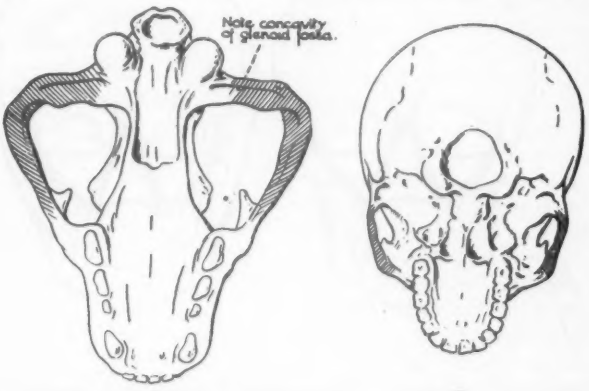


Fig. 2.—Drawings of base of skulls of A, carnivore, and B, human being, showing relative differences in form, glenoid fossae and zygomatic arch width.

2. The base is not uniform. (Fig. 2.) In animals in which the teeth are columnar and blunt, the base is rounded and less strongly formed. The attachments of the pterygoid muscles are large, while the zygomatic arches lie close to the skull and are more nearly parallel with its sides; but, in animals whose teeth are sharp-bladed, like the cat's, and whose jaws are used for fighting, great strength and precision of movement are necessary. The base of the skull is flat, very strongly formed and with wide zygomatic arches. The attachments for the pterygoid muscles are very small.

3. The symphysis of the mandible is sometimes movable and sometimes immovable. In carnivora, in which the greatest power is necessary and the upper teeth completely overlap the lower, the symphysis is always slightly movable through a fibrous suture.

The Masseter.—The masseter is a very powerful muscle attached to the mandible. Its origin is given as the zygomatic arch. Attached to the upper border of the zygomatic arch and continued around the skull is the galea aponeurotica, a tough, inelastic, tight-fitting skull cap. When the masseters contract, the pull passes through the zygomatic arches, to be transmitted by the galea aponeurotica evenly over the entire vault of the skull. It would be possible for the masseter to function as I have shown in Figure 3, but, by attaching it to the zygomatic arch, Nature has bound the skull more closely to the mandible. Furthermore, as I shall describe later, by modifying the design of the zygomatic arch, she can change the line of action of this muscle to assist better the functioning of teeth required by the various species. Before finishing with the mas-

seter, it might be as well to consider the temporal muscle, for the action of one partly explains the action of the other.

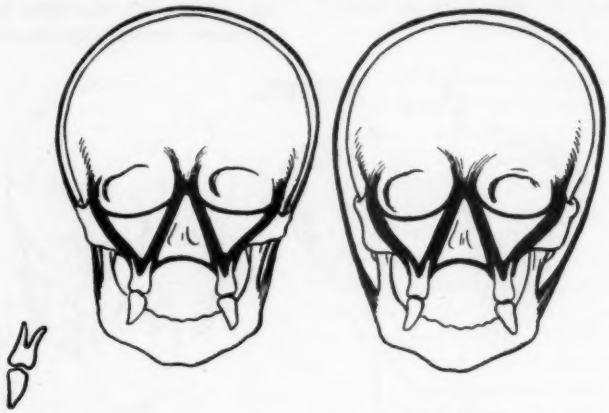
The action of the temporal muscle is not as described in the textbooks. Its action is most easily understood by referring to the carnivora. (Fig. 4.) When the temporal muscle contracts and pulls the high coronoid process backward, the anterior part of the mandible is raised and the posterior part, including the condyle, lowered. If the posterior part of the mandible were not supported, the temporal muscle would put a severe strain on the ligaments binding the condyle in the glenoid fossa. It is here that the action of the masseter is intimately associated with the temporal, for, having as its base the whole vault of the skull, it can raise the posterior part of the mandible, harmoniously supporting the joint against any contraction of the temporal.

Strong temporal muscles are always associated with strong masseter muscles.

In order to understand better the action of the muscles,, it will be necessary to examine further the architectural plans of certain animal skulls.

Carnivora.—The cats use the front teeth for killing and fighting and the posterior teeth for cutting food as distinct from grinding. We find in these animals sharp-bladed cheek teeth. The upper cheek teeth completely overhang the lower, and in action receive the stress of mastication at right angles to their long axes. (Fig. 5.) There is always some movement at the symphysis, and never a bony union. The base of the skull is flat, with wide sweeping zygomatic arches. The masseter and temporal muscles are very powerful, while the pterygoids are weak. The condyles are almost cylindrical, with their axes in the same transverse plane, and are free to move laterally in a small segment of a circle whose center is the symphysis. (Fig 2.) They fit the glenoid cavity so accurately that it is sometimes difficult to disarticulate the jaws. The line of occlusion is flat and at right angles to the line of action of the masseter muscle.

Herbivora.—A sheep chews its food with only the posterior teeth. (Fig. 6.) There can be no great stress on the anterior part of the jaws. The cheek teeth, which are columnar, grind the food. In



A B

Fig. 3.—Diagrammatic drawing of frontal aspect of human skull, showing: A, arrangement of galea aponeurotica attached to zygomatic arch, and B, mechanical interpretation of this arrangement. The heavy lines originating at the upper molars indicate lines of masticating stresses.

grinding, the stress of mastication must pass vertically through the tooth and not laterally as in cutting. (Fig. 7.) The base of the skull is more rounded and the zygomatic arches are flatter and almost parallel with the sides. The masseter and pterygoid muscles are large, while the temporal is small. The condyles are flat and move over a plane surface of the temporal bone. The line of occlusion of the cheek teeth is flat and at right angles to the line of action of the masseter.

Rodents.—In rodents the incisor teeth are used for gnawing. The skull is similar to that of the herbivora, except that the condyles are cylindrical, with their axes in the anteroposterior plane, and

Fig. 4.—Lateral view of carnivorous skull, showing rotary nature of mandibular stroke as induced by pull of temporal muscle acting on coronoid process.

moving through a glenoid cavity which is a large anteroposterior groove.

Kangaroo.—The kangaroo has large incisor teeth combined with herbivorous molars. The base of the skull is rounded and the condyles resemble those of the herbivora. The masseter, temporal and internal pterygoid muscles are all large. The line of occlusion of the cheek teeth is at right angles to the line of action of the masseter, but the masseter runs upward and backward from the mandible.

Man.—The teeth of man are intermediate between those of the carnivora and herbivora, for, as in the herbivora, the cheek teeth meet almost end on, and, as in the carnivora, there are incisors and canines. The zygomatic arches are close to and nearly parallel with the sides of the skull. The temporal, masseter and internal pterygoid muscles are more evenly balanced, while the condyle and the glenoid fossa resemble those of both the carnivora and the herbivora. The line of occlusion of the cheek teeth is, in the main, at right angles with the line of action of the masseter, which, in man, runs from the mandible upward and slightly forward. (Fig. 8.)

In my description of the masseter muscle, I said that, by modifying the design of the zygomatic arches, Nature could change the line of action of the masseter to better assist the teeth designed for the various species. By comparison of the architecture of the skulls that I have just discussed, this statement will be explained. The cheek teeth of the carnivora differ from those of the herbivora in that those of the carnivora, cutting as sharp-bladed shears, bear the stress laterally, whereas those of the herbivora, meeting end on, bear the stress vertically. (Figs. 5 and 7.)

As I have said above, the base of the carnivora skull is flat, the zygomatic arch wide out from the sides of the skull and the symphysis of the mandible always slightly movable. The direction of the masseter muscle is more outward than upward from the mandible; consequently, when it contracts, not only will it raise the posterior part of the mandible, but, just as important, the movable symphysis will allow a widening between the rami and bring into action the cheek teeth of the lower jaw, which at rest lie completely inside the teeth of the upper jaw. It might be well to emphasize that, in cutting food, the stress passes through the cheek teeth of carnivora at right angles to their long axes and not, as in man, parallel with their long axes. Unless this is quite clear, we cannot understand the action of the mas-

seter. An examination of the condyle and glenoid fossa will reveal how carefully Nature has planned the joint to make this action possible. In some animals with particularly strong jaws, such as the Tasmanian devil *(Dasvurus Ursinus)*, Nature extends the temporal process of the malar bone to the outer end of the glenoid fossa to prevent the masseter from pulling the condyle laterally out of the fossa.

In the herbivora, since the teeth meet end on, the architecture of the skull is modified. To make the grinding action possible, the zygomatic arches are brought closer to the skull, and the internal pterygoid muscles are developed to act with the masseter in swinging the mandible from side to side. The condyles are flattened to conform with a glenoid fossa that will best serve the muscles.

Condyle and Glenoid Fossa.—We have observed many shapes and forms of condyles. In carnivora, they are cylindrical, with their axes in the same transverse plane. In herbivora, they are more or less flat surfaces, and, in rodents, they are again cylindrical, but their axes are in the anteroposterior plane.

The glenoid fossa follows the changes of the condyle. In the carnivora, the fossa accurately enfolds the condyle and is strongly formed by the squamous temporal fossa. In herbivora, it is almost a plane surface of tissue-paper thickness, and, in man, it is a weakly formed fossa comprised of a squamous part and the tympanic plate of the temporal bone; but the condyle and the glenoid fossa have something in common with the muscles of mastication: whenever power and precise movement are necessary in the anterior part of the mouth, we find a powerful temporal muscle and a highly specialized condyle.

What, then, is the function of the condyle? for, as I have shown in my description of the temporal muscle, and just now in the architecture of the glenoid fossa, it cannot bear any stress against the temporal bone.

There is a function demanded of teeth and jaws which does not apply to civilized man and which is of great importance to animals, especially the carnivora: the function of fighting, in which the power, rapidity and precision of the blow which the mandible makes against the upper jaw are of paramount importance. If the jaws were slung by muscles and ligaments alone (both condyles are sometimes surgically removed in man), power and rapidity of movement would not be hindered, but immediately the condyle is added to the attachment, the most precise action is possible. This, then, is the explanation of the closed, accurately fitting joint of the carnivora and the open one that is observed in the omnivora. Where precise movement is not necessary, Nature has modified the joint to satisfy the requirements.

Fig. 5.—Sketch of frontal section through carnivorous face, indicating rest position of mandibular and maxillary teeth, with buttressing of zygomatic arch to withstand stroke as indicated by arrows.

ADAPTABILITY TO THE INDIVIDUAL

The second part of my statement given

above is that Nature modifies her original plan of the skull and adapts it to suit the varied tooth patterns of the species.

While some characteristics are common to all skulls, the varied tooth patterns demand a modified architecture. Masticatory stress in the incisor region is nearly always vertical, but, in the premolar and molar region, it varies. Sometimes, it is vertical, as in man, and, sometimes, it is directed laterally, as in the carnivora. (Figs. 5 and 7.)

The characteristics common to all skulls are:

1. There are always two hard parts, vault and mandible, that are separated by a weak part, face bones.

2. The mandible is a completely separate bone.

Fig. 6.—Skull of sheep, showing direction of occlusal line in relation to pull of masseter.

3. The upper jaw is immovable and is attached to the skull by columns of bone that pass through the weak face bones. In discussing the muscles of mastication, I pointed out that, by attaching the masseter to the zygomatic arch, Nature is able to change the direction of the line of action of this muscle to best serve her varied tooth patterns. I now wish to emphasize that this attachment, binding and fixing the skull to the mandible, makes the action of all the muscles of mastication more exact and more certain; and, as the lower jaw presses against the upper, the skull is caught firmly in this galea masseter press, and, by this process, whatever upward force is used is equalized and dispersed through the vault of the skull. (Fig. 3.)

Unless this is clearly understood, it is impossible to understand the beauty hidden in the anatomy of the skull. It is the key to the anatomy of the dentition, without which, to the dentist, the study of anatomy is meaningless drudgery. It is the key to the difference between empiricism and science in dentistry.

In describing the skull of the carnivora (Fig. 5), among other things, I said that the cheek teeth are used for cutting food as distinct from chewing. The upper cheek teeth completely overhang the lower and, in action, receive the stress of mastication at right angles to their long axes. In my description of the masseter muscle, I related how, by its lateral disposition in carnivora, its action will widen the distance between the rami and allow the buccal surface of the lower cheek teeth to shear along and against the lingual surface of the upper cheek teeth. It is perfectly clear that there can be no upward thrust through the long axes of the upper teeth, as there is in man, but there is a very powerful outward thrust, because these teeth shear like the blades of scissors.

To make this action possible, Nature builds wide zygomatic arches and, as the masseter pulls the lower cheek teeth outward toward the teeth of the upper jaw, it also pulls on the zygomatic arches, with an equal and opposite pressure.

Since the pull on the zygomatic arches

is inward and not upward, as in man, a glance at a carnivora skull will show how by flattening the base, i.e., hard palate, palate bones, body of sphenoid and malar bones, Nature has strengthened these arches against the pull of the masseter. (Fig. 2.)

Furthermore, since there is no upward thrust, as in man, there is no need for a postorbital bar; consequently, there is no bony partition between the orbital cavity and the temporal fossa. (Fig. 4.)

In describing the human skull (Fig. 7), I said that the cheek teeth occluded almost end on and that the stress of mastication must pass vertically through their long axes, in contradistinction to

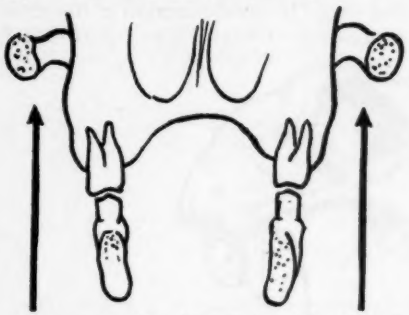


Fig. 7.—Sketch of frontal section through herbivorous face, indicating lines of masticatory stress.

the direction of the stress passing laterally through the teeth of the carnivora. The zygomatic arches lie close to the sides of the skull. The direction of the line of action of the masseter is almost vertical. It is obvious that when the mandible squeezes the skull in the galea-masseter press, the forces must pass vertically through the face bones. Now, since the molar teeth are immediately below the orbital cavities and the temporal fossae, a bony column is developed between these fossae to diffuse masticatory force through the vault.

In describing the skulls of the carnivora, kangaroo and man, I said that the line of occlusion of the cheek teeth was at right angles to the line of action of the masseter. It will be observed that, in each instance, the line of action of the masseter varies slightly. In the carnivora, it is upward and outward; in the kangaroo, it is from the mandible upward and backward, and, in man, it is upward and slightly forward. In each instance, the line of occlusion has followed the line of action of the muscle, and, in each instance, if we examine the skulls, we find a modified glenoid fossa.

I should suggest here that the condyle and the glenoid fossa have been designed to suit the convenience of the teeth, and not the teeth to suit the condyle and the glenoid fossa.

ADAPTATION TO THE INDIVIDUAL

With this short survey of comparative anatomy, we are prepared for the third part of my statement: When accident occurs, Nature still further modifies her architectural plan to best serve the individual.

Wolff, in his law, states: "Every change in the form and the function of bones, or in the function alone, is folfollowed by certain definite changes in their internal architecture, and equally definite secondary changes in their external conformation in accordance with mathematical laws."

I shall confine myself to the human skull, and apply what I have observed in my comparative work, always bearing in mind that Nature determined the architectural plan of the skull to make the action of the teeth possible.

Disposition of the Teeth.—Nature, in building the dental apparatus, requires a long period of time—twenty years or more—and from the beginning of the formation of the first dental follicle and the tissues that support and precede it, to the eruption of the last molar, she works in accordance with a definite plan toward a definite end; viz., the production of a type that has been the type of man's denture as long as man has been man.

In normal occlusion each dental arch

describes a graceful curve. The teeth of these arches are so arranged as to be in greatest harmony with their fellows in the same arch, as well as with those in the opposite arch.

In their normal relations, the external curve of the lower arch is slightly smaller than that of the upper, so that in occlusion the labial and buccal surfaces of the teeth of the upper jaw slightly overhang those of the lower jaw. The anterior half of the upper molars occludes or presses on the posterior half of the lower molars. The teeth anterior to the first molars interlock with one another in the interspaces until the incisors are reached; of these the upper usually overhang the lower about a third the length of their crowns, though the length of the overbite varies.

It will thus be seen that each of the teeth of both jaws has two antagonists or supports in the opposite jaw, except the lower central incisors and the upper third molars. As the inclined planes of the cusps match and harmonize most perfectly in the bucco-occlusal relations of the teeth, so there is a similar arrangement in their linguo-occlusal relations, except that the lingual cusps of the lower buccal teeth project beyond those of the upper into the oral space.

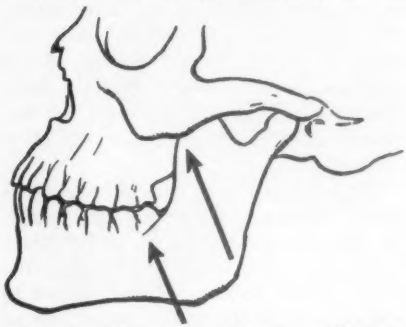


Fig. 8.—Sketch of architecture of human face, showing curve of Spee arranged at right angles to main pull of masseter muscle.

Likewise in transverse arrangement the buccal cusps of the lower molars and premolars rest between the buccal and lingual cusps of the uppers, and the lingual cusps of the upper molars and premolars rest between the buccal and lingual cusps of the lower.

The grinding surfaces are thus enormously increased in extent and efficiency over what would be possible if they consisted of a single row of cusps or of plane surfaces. But increase of masticatory surface is not the only reason for this complex interdigitation of the cusps and inclined planes of the teeth, but it is of equal importance in providing for the teeth a mutual support. The sizes, forms, and interdigitating surfaces, and position of the teeth in the arches are such as to give one another, individually and collectively the greatest possible support in all directions. (Angle.)

The roots of the upper molars and premolars are disposed in two rows, buccal and lingual; while the roots of the lower molars and premolars are always in a single row, anteroposteriorly. From the foregoing description, there are four points that I wish to explain:

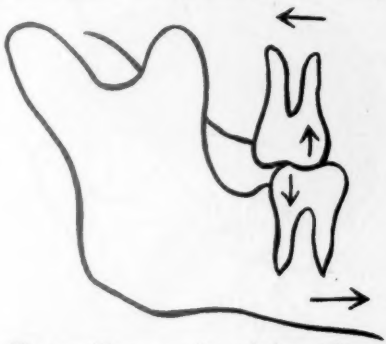


Fig. 9.—Human molar relation. The arrows indicate the lines of the face and their resultant growth influences.

1. Occlusion of the upper molars on the posterior half of the lower molars.
2. The overhang of the teeth of the upper jaw.
3. The occlusal curve of the teeth; curve of Spee.
4. The double row of roots of the upper molars and single row for the lower molars.

In explaining the first three parts, it must always be remembered that, from infancy, the skull is growing in all directions and that it continues growth until

the last molar tooth erupts and takes its position, when the spheno-occipital suture, the last suture in the skull to do so, unites.

It was pointed out to me by Prof. Wood Jones that, while the sutures close at certain times, such as 2 years, 12 years, or between the eighteenth and twenty-fifth year, what is much more important is that those times coincide with the eruption of particular teeth; so that instead of teaching that the spheno-occipital suture, for instance, closed between the eighteenth and twenty-fifth year, it would be more exact and more informative to describe the time as synchronous with the eruption of the last molar tooth.

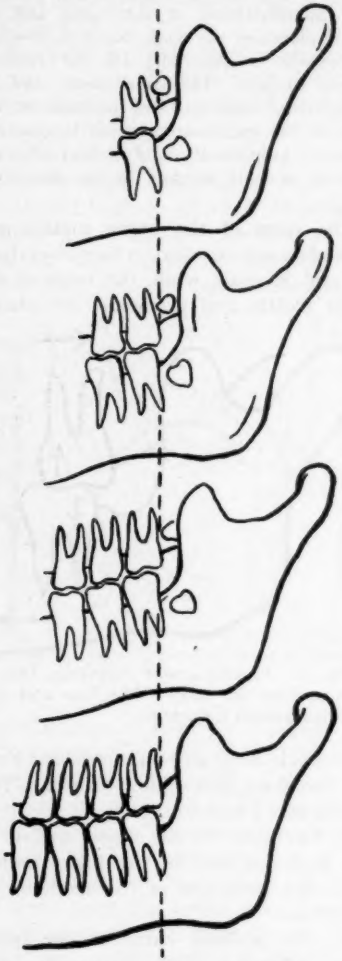


Fig. 10.—Series showing effect of erupting teeth on anterior driving of denture.

We must remember that, between the second deciduous molar and the ramus, there must be sufficient growth to accommodate the three permanent molars. During development, the occlusal surface of the mandibular molar is directed forward in its crypt and, during eruption, the tooth rotates upward and backward to articulate with the upper molar, so that the weight of mastication is received on the posterior half of the lower molar. (Fig. 9.) This will tend to move the apices of its large roots forward, giving a stimulus to forward growth in the body of the bone, and making room for the growth and development of the next posterior molar.

In the upper jaw, the reverse takes place. During development, the occlusal surface of the upper molar faces backward, and, during eruption, the molar rotates downward and forward to articulate with the lower molar and so receive the weight of mastication on its anterior half. This will tend to tip the large roots backward, giving a stimulus to bone growth in the region of the tuberosity and the floor of the antrum. If, for any reason, the lower molar, on articulating with the upper, received the weight of mastication on its anterior instead of its posterior half, it is obvious that the forward rotation of its roots would be impeded, and development of the mandible would be prevented between the last molar tooth and the ramus.

I have referred above to the mandible as representing a hammer that strikes on an anvil. Now, if the teeth are not in their correct positions, the direction of the blow will be out of harmony with

Nature's design, and, as I shall describe later, malformation will follow.

When the first molar takes its place in the dental arch, the second permanent molar is forming, and, in developing, it pushes that part of the mandible anterior to itself forward, just as a growing plant will push rocks out of its way. If the roots of the first permanent molar have moved forward as Nature intended, the second and third molars will develop normally, but, if the weight of mastication is on the anterior half of the first molar, it is almost impossible for the posterior molars to develop and erupt normally.

I have mentioned above that the upper teeth overhang the lower teeth, and that each tooth of both jaws except the lower central incisors and upper third molars has two antagonists or supports in the opposite jaws. Further, each tooth of each arch is in immediate contact with its neighbor, and the points of contact form a line parallel with the line of occlusion.

This seems very simple, but what is interesting is that this arrangement is characteristic of man. Man is the only living primate that has its teeth in a continuous series, and it is one of his distinctions that there are no gaps between them. (Wood Jones.)

We saw above how Nature modifies the zygomatic arch to meet the requirements of the various species. Let us now determine why Nature has given man such an unusual arrangement of teeth.

There are three other anatomic conditions, already mentioned, that must be kept in mind.

1. The two strong parts in all skulls: vault and mandible and the intervening weak part, the face bones. An examination of the human skull will reveal that the long axes of these strong parts are not parallel, but approach each other posteriorly and diverge anteriorly. When the skull is squeezed in the galea-masseter press by the muscles of mastication, the face bones are caught between two non-parallel lines of resistance like a nut in a nutcracker. Under the influence of the forces of mastication, the face bones will, taking the line of least resistance, drift forward.

Fig. 11.—Caricature showing how unbalance of forces can lead to distorted facial pattern of Class II variety.

Fig. 12.—Drawing showing unbalance of faces leading to distorted facial pattern of Class III variety.

2. In functioning, the stress of mastication passing through the posterior half of the lower molars tends to rotate their large roots forward in the body of the

mandible and promote the forward growth of bone. (Fig. 9.)

3. The molars, in developing, will naturally require more room in the body of the bone, and, in erupting, will push forward the teeth anterior to themselves. (Fig. 10.)

With these considerations in mind, I should suggest that by designing the upper teeth to overhang the lower, Nature still further insures the growth of the face bones. The strong lower jaw in growing forward will carry the upper jaw with it, this insuring the growth and development of the nose and accessory sinuses.

RELATIONSHIP BETWEEN THE LINE OF OCCLUSION AND THE LINE OF ACTION OF THE MUSCLES OF MASTICATION

In describing the actions of the muscles of mastication, we considered some architectural characters of skulls. Among other things, I said that the line of occlusion of the cheek teeth was at right angles to the line of action of the masseter muscle. The line of action of the masseter varies. In man, it is upward and forward from the mandible. In the kangaroo, it is upward and backward. It is curious to note how the line of occlusion in each case has followed the line of action of the muscle. I shall apply this later in modifications due to accident.

The upper cheek teeth have two rows of roots, while the lower teeth have a single row. In the carnivora, the lines of stress from the occlusion of the cheek teeth run laterally. One might say that the lingual surfaces of the upper cheek and the buccal surfaces of the lower cheek teeth are their occlusal surfaces. There is a different buttressing for these teeth. The skull is wide and flat. (Fig. 5.)

In man, the structure of the cheek teeth is influenced by two powerful muscles, the masseter and the internal pterygoid, whose combined actions are vertical. It is obvious that the architecture of the human skull will differ from that of the carnivora. (Fig. 7.)

In an earlier part of my paper, I likened the mandible to a hammer that strikes on an anvil. A hammer strikes an anvil more or less at a point. The function of an anvil is to diffuse force over a large base. The lower teeth, broadly speaking, are columnar, like the head of a hammer, but the upper teeth have widely spreading roots to diffuse force through the skull by columns of bone that, as I previously mentioned, pass through the face.

In architecture, columns, beams and flying buttresses are used to support weights or, through them, stresses pass to be dispersed elsewhere. In the skull, Nature uses the same devices, allowing the forces excited by the lower jaw to be transmitted through the weak face bones and dispersed through the skull.

Connecting the upper denture with the skull are three main columns of bone: (1) the anterior orbital column, (2) the posterior orbital column and (3) the pterygoid column.

Acting as cross-beams and buttresses are, among others, the hard palate, walls of the orbit, zygomatic arches, palate bones, lesser wing of the sphenoid, etc.

The skull is squeezed down onto the mandible by the muscles of mastication acting through the galea-masseter press. The whole vertical force is received by the upper teeth, whose roots, being widely spread in two rows, are best designed to diffuse force through the bony columns of the skull. The lower teeth, whose roots are in a single row, are best designed to deliver force, as is the hammer that strikes the anvil.

When an accident occurs, Nature still further modifies her architectural plan to best serve the individual. Under accidents, I shall consider:

A. Loss of space in the line of the contact points of the dental arch from the last molar on one side to the last molar on the other side.

B. Loss of resistance to the muscles of mastication.

C. Abnormal lines of stress passing through the skull.

A. Loss of space, etc.

To appreciate the first condition, we must remember several anatomic arrangements that promote growth of the bones of the face.

1. The nutcracker action of the two strong parts and the intervening weak part.

2. The lines of masticatory stress passing along the distal half of the lower molars.

3. The forward pressure between the last molar and the ramus, from the developing molars, and acting through the points of contact.

Any accident that interferes with these conditions will, in proportion, interfere with the development of the face bones. Of the three conditions named above, the third is the most important here.

Loss of space due to shortening of the line of occlusion may be caused by (1) proximal caries or (2) loss of teeth.

Each tooth is designed by nature to a particular pattern; and each tooth is different from every other tooth in its own half of the jaw, both in size and in shape. Yet, in occlusion, they fit most perfectly, as the cogs of a wheel.

In growth and development, by their interlocking, they move in harmony with the growing jaws. If proximal decay develops, the shape of the tooth is changed and, in proportion to the number and size of the decay areas, the cogging or interdigitating of the teeth will be upset, and will work against the other conditions of Nature. For instance, if the distal half of the first molar is lost, there can be no masticatory stress down the posterior root. The second molar will grow forward toward the cavity and will be unable to push the teeth anterior to itself forward because of loss of contact point.

What applies to loss of tooth substance through caries is even more applicable to loss of teeth; for, in this instance, greater space is lost.

It is apparent that, in restoring space lost through decay or the loss of teeth, not only must the space be repaired, but also the original shape of the space must be remodeled.

B. Loss of resistance to the muscles of mastication. The several anatomic factors are:

1. The power of the internal pterygoid and the masseter muscles.

2. The galea-masseter pressure that clamps the skull to the mandible.

3. The position of advantage of the line of occlusion of the molar and premolar teeth for checking the powerful closing action of the muscles of mastication.

With these conditions in mind, it is easy to understand how the loss of any teeth will weaken resistance to the powerful muscles. For instance, Nature has designed that the first molars shall erupt when the temporary molars are strongest. This gives sufficient time for the bone surrounding the molars to strengthen, enabling it to withstand the forces of mastication while the premolars are developing. If the large first molars are lost, the resistance to the muscles will be weakened. Consequently, when the skull is squeezed down onto the mandible, vertical height will be lost, and a closed bite will result.

As I have related above, the temporal muscle raises the anterior part of the jaw and the masseter raises the posterior part and relieves any downward pressure on the ligaments. If there is no check to limit the action of the masseter, it could unduly raise the condyle and cause irritation in the glenoid fossa, and this fossa was never designed to withstand pressure.

C. Forces passing in abnormal lines through the skull. The several anatomic conditions directly bearing on this condition are: (1) the galea-masseter pres-

sures, (2) divergence of the axes of the two hard parts of the skull and (3) the stress of mastication passing through the posterior half of the lower molars and the anterior half of the lower molars.

You will observe that when the jaws close normally in the conditions that I have mentioned, the stress of mastication will pass almost vertically upward through the face bones and downward through the mandible. Under these conditions, the whole anatomic arrangement will promote normal growth of the face. If, for any reason, the first molars on eruption receive the weight of mastication on the anterior half instead of on the posterior half, their large roots will be prevented from rotating forward in the body of the mandible. This will, first, impede growth between the molar and the ramus and, secondly, change the direction of the line of stress from mastication. The lines of force will be upward and forward through the face bones, and downward and backward in the mandible. The face bones will flow forward, as I have illustrated. With the face bones flowing forward and the mandible not developing, a change will occur in the line of action of the masseter and internal pterygoids. In order to receive the resultant force of these muscles at right angles to their action, the line of occlusion of the molars will raise posteriorly, curving upward as I have illustrated. If, through accident, the position of the teeth is changed so that the lower teeth rotate too far forward, and the lower incisors bite outside the upper teeth, the architecture of the skull will change. (Fig 12.) There will be a flowing forward of the body of the mandible. The line of action of force in mastication will change so that it will pass upward and backward in the face bones and downward and forward in the mandible. The face bones will be caught in a reverse nutcracker action and be pressed back under the skull, and normal growth and development of the nose and accessory sinuses will thus be prevented. The mandible will flow forward and a large chin will result, to best support the anterior teeth in their abnormal position. The line of action of the masseter and internal pterygoid muscles will change to move upward and backward, and the line of occlusion will change to resist better the action of these muscles, as I have illustrated.

In this essay, I have discussed briefly anatomy and human anatomy, general and special dental anatomy and architecture. There were three themes used: First, the care Nature took in determining her original plan of the skull; secondly, how this design is modified to serve the varied tooth patterns demanded by the many species, and, thirdly, how, when we meet with an accident, Nature will still further change the skull to best serve the individual.

On the basis of these three themes, I make the perhaps daring statement "that Nature designed the skull to make the actions of the teeth possible, and that any protection the skull gives to delicate parts is for convenience and not of necessity."

This is of fundamental interest to dentists, for it introduces dentistry as an art. It is a creative art, in contradistinction to surgery, which must of necessity be destructive. I do not wish to suggest that I am unmindful of the good work that has been done in dental surgery, but I wish to emphasize the pleasure and the satisfaction to be gained in the planning and the execution of the best in dentistry. We are all aware of the possibilities of orthodontia, and the beautiful ceramic and other conservative work that is possible today. The time taken to do this kind of work is of no more consequence to the operator than time is to the artist creating a beautiful picture, but care, trouble, infinite pains to gain the desired results are common to both. Art is an expression of form, and what art could be higher than that of helping Nature express herself through the human face?

CONTACTS AND CONTOURS

By A. Hubert Fee,* B.A., D.D.S., Richmond, Va.

INTRODUCTION

G. N. JOHNSON[1] once said:

> The two terms, contact point and interproximal space, should be an open book to any practitioner of dentistry. . . . Nature has done her best in the way of making an anatomic arrangement to avoid trouble. . . . It remains for the dentist to assist Nature by copying as best he may the arrangement thus provided, when he attempts to make fillings on the proximal surfaces.

NECESSITY FOR CONSIDERATION

Why has it been necessary for Dr. Johnson, as well as many other writers on operative dentistry, to admonish us as to the need for proper treatment of the proximal contours and their contact points? Prime[2] suggested that there are only twenty occlusal, but sixty proximal, surfaces in a full complement of teeth. Ferrier,[3] surveying restorations made by a gold foil study club, found that 41.47 per cent of 12,000 fillings were of the proximal type. Day and Sedwick,[4] in a survey of 11,058 teeth having 7,754 cavities, found that 28.5 per cent were on proximal surfaces. These and other tabulations show that nearly one-third of all cavities which operative dentists are called upon to restore are of the proximal type.

Prime,[5] in his great story "Is Operative Dentistry Failing?" challenged operative dentists to put forth their best effort and take advantage of their knowledge and ability. Aiguier[6] states:

> Predisposing factors to periodontoclasia are fillings instead of restorations. . . . Any overhang will eventually cause destruction of supporting tissues. . . . Often times, the interproximal contact is neglected. This may permit the packing of food into the interproximal space, with its known result.

Spalding[7] asserts:

> The prevention of gingivitis may in some instances consist of so simple a procedure as the conscientious finishing of borders of plastic fillings; the prevention of food impaction; providing proper contact and contour for restorations; etc. . . .

Salvas[8] has found that pocket formation is most frequently found in the interproximal spaces on the lingual surfaces of the teeth, especially of the molar and bicuspid teeth. (Figs. 1 and 2.)

These conclusions indicate that operative dentists have a responsibility to meet in order to avoid continued criticism from their specializing colleagues, as well as from some of their own group. Some need pay only a little more attention to the application of their knowledge and technic, while others must review fundamentals and catch up on the results of modern research. We have only to recognize the causes of our failures to realize that these are the fundamentals upon which our practices are built.

EARLY TREATMENT

"Contacts and contours"—location, susceptibility to dental decay, treatment and rôle in preventive dentistry—have been considered in theory and practice for centuries. As far back as 455 A. D., Aetius recorded his procedure of filing contact points to eliminate proximal caries and separating the teeth to prevent

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Read before the Section on Operative Dentistry at the Eighty-First Annual Session of the American Dental Association, Milwaukee, Wis., July 20, 1939.

its recurrence. Such a technic was probably justified when little was known of the basic sciences and technics of handling dental materials. The filing of contact points was practiced through the centuries, with some rather futile attempts to restore proximal cavities with tin and gold foils. In the middle of the nineteenth century, dentists of this country went to extremes and over-contoured their fillings. In 1871, the eminent dentist Robert Arthur[9] revolted against this practice and attempted to discourage it in his book "Treatment and Prevention of Decay of the Tooth." He advocated ". . . a new method of filing the contacts and proximal contours to permanently separate the teeth." Although Dr. Arthur lost his cause, he succeeded in awakening

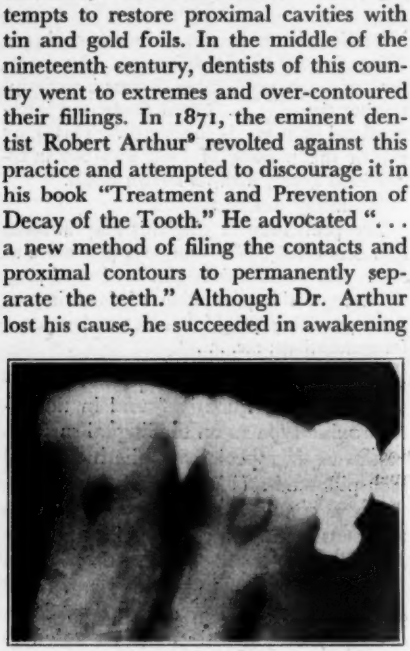

Fig. 1.—Localized pocket formation from overhanging margins.

the dental profession to the necessity of treating contacts and contours in a more scientific manner.

From that time, we have gradually progressed in knowledge and skill by using the findings of our own and associated research workers.

We have been unfortunate in that little has been written concerning the characteristics of contacts and contours as applied to operative dentistry. Our authors were satisfied with stressing the importance of properly restoring tooth surfaces, with the result that little mention was made of anatomic characteristics. Stillson[10] and Schwartz[11] made some standardizations of those areas and attempted to indicate, in general, the positions of contact points. They have shown trends and consistency in the shape of interproximal spaces, in proximal contours and in resulting embrasures. The greatest bulk of information on this subject, however, comes from research workers in the fields of physics, embryology, periodontia, physiology, anatomy, histology, pathology, nutrition and caries. The operative dentist still needs much information regarding this subject.

Rabkin[12] states:

Genetically, the teeth and jaws retain the physical and anatomic properties specific to the individual, and departure from the physical constancy and physiologic requirements

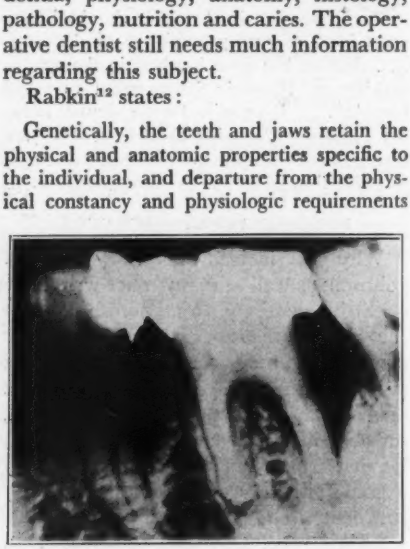

Fig. 2.—Localized pocket formation from overhanging margins.

usually leads to alterations of the dental apparatus which is subject to degenerative changes. The basic features retaining specific identity of the original type of man are: large skull, broad and fully rounded dental arches, deep and heavy mandibles, thick and compact bone, and sturdy masticatory apparatus with a lesser tendency to dental disease. The light-weight thin bone, irregular shaped jaws, distorted arches and teeth are common features of the contrasting type which yields to dental complications.

There seems to be little doubt that civilized races, which eat domesticated foods, are showing traces of deviations in their dentitions from the ideal just described. Malocclusion, largely through

tooth irregularity and jaw deformity, is increasing in this country. Findings in our American clinics differ considerably from those made by Waugh and Price, whose photographs of natives clearly show a trend toward the types of jaws and teeth found in primitive man. (Figs. 3, 4 and 5.)

Stein[13] writes: "Through the loss of differentiating features, the teeth of man are becoming more alike." Hrdlička[14] said:

Thus not only each individual jaw and set of teeth, but each individual tooth and feature of jaw or tooth, presents its own problems that call for intelligent appreciation, and may affect your latitude in dealing with them. It follows, except in a very general way, that the jaws and teeth of any given subject must, in the practice of dentistry, always receive individualized study and attention.

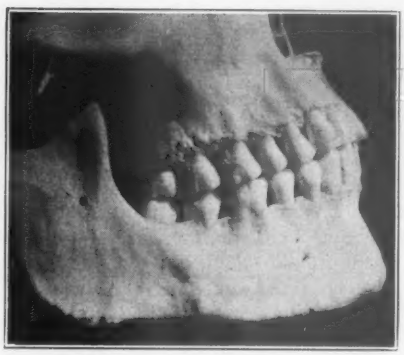

Fig. 3.—Heavy, well-shaped arches of primitive type.

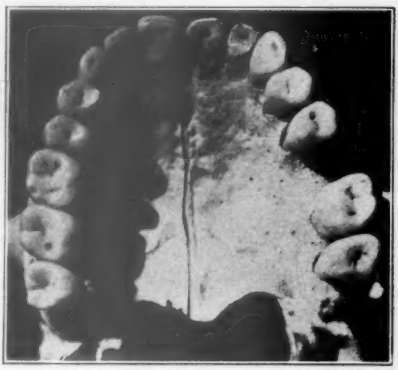

Fig. 4.—Heavy, well-shaped arch of primitive type.

Williams[15] went further, disproving the relationship between tooth form and the shape of the skull. He classified teeth into square, ovoid and tapering types.

Point contacts, with their radiating embrasures, when formed by the approximation of two spheres, are ideal in form to resist the inroads of proximal decay. Here, the contacts are really points, and the diverging embrasures permit an easy egress of food particles, without danger of retention of remnants. Early in life, the masticatory apparatus begins to break down from caries and loss of teeth. Hirschfeld[16] has traced eighty abnormalities resulting from the loss of a single tooth, through caries, and has found that resultant drifting brings about changes in contact relationship. Schour[17] writes:

Histologically the physiologic mesial drift results, clinically, in the abrasion of contacts with age and occlusal stress. When these contact points are incorrectly placed, the anterior component forces tend to rotate that tooth out of the line of the arch.

Brodie[18] says:

Any abnormality in tooth form that throws into disharmony the relationship that should normally exist between upper and lower arches is very apt to cause malocclusion. A tooth that is too large or too small either by formation or poor dentistry is in the same category. A poorly contoured or badly restored filling may liberate forces, which in turn create disturbances at remote points.

The deformities of nature present one set of problems; the inroads of caries, another; poor dentistry, a third. Bossert[19] has shown that where the index of cusp steepness in molars is less than 50, there is a prevalence of decay in 36 per cent of the teeth; but where the index is more than 50, 47 per cent of the

teeth become carious. Doxtater[20] associated the occlusal cavity with the approximal one in the following statement:

If we have any susceptibility to approximal caries it will be exaggerated in a mouth where there are leaking occlusal fillings, and the approximal caries will be more damaging when associated with caries burrowing down into the tooth from the leaking occlusal filling."

Beust[21] found that:

Interproximal caries in enamel begins, in practically all cases, at the actual point of contact of a tooth with its neighbor. . . . The presence of an acid-secreting plaque or colony at this point is environmentally and mechanically impossible.

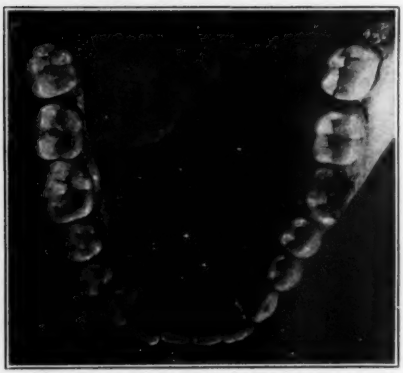

Fig. 5.—Heavy, well-shaped arch of primitive type.

Bodecker[22] proposes that teeth have a variable resistance to attack. His suppositions are based on finding 179 carious lesions affecting only one of two contacting teeth in 516 cases examined. Miller[23] has written:

Enamel of different persons, as well as the different teeth of the same person, and different parts of the same tooth, does show differences in resistance to acid.

Although Hrdlička and others have dissociated tooth form from that of the skull and the dental arches, there seem to be characteristics common to the three different types of teeth. Where there may be great differences in the length and breadth of crowns and in labial, buccal and lingual contours, it will be found that teeth of each type have certain characteristics in the shape of the proximal surfaces and location of contact points, which are common to most teeth of that type.

PHYSICAL CHARACTERISTICS

The following descriptions are a correlation of previous studies with my own observations of approximately 12,000 patients during the past five years. In this discussion, one should recall Kloehn's[24] findings:

There is a definite relationship between occlusal stress and tooth form . . . the human dentition is the only one with continuous arch form and full mutual contact.

TAPERING TYPE

Contacts of maxillary central and lateral incisors are nearly at the incisal angles, and slightly labially of the incisal edge. The cuspids are very angular in all directions, with the mesial contacts close to the incisal edges, and the distal contacts near the center of the distal surface. The tapering type of bicuspids are likewise angular, with wide crowns, narrow necks and long cusps. The latter may form from one-third to one-half the entire height of the crown. As these crowns taper lingually, the contacts are forced buccally almost to the buccal line angles. Since nearly all contact points are approximately 1 mm. toward the gingival line from the crest of the marginal ridge, the bicuspid contacts of this type of tooth will be found just gingivally from the junction of the occlusal and middle thirds of the crown. Mesial contacts of the molars are almost out on the mesiobuccal line angles, and from one-third to one-half the distance from the occlusal surface to the cervix. The distal contacts shift lingually into the middle thirds and are midway of the

height of the crown. Lingual shifting of the contacts is more noticeable in the mandibular than in the maxillary molars. No definite position can be set for the mesial contact of the mandibular second molar and the distal contact of the approximating first molar owing to the fact that the third buccal cusp of the first molar presents many variations in contour and position.

The proximal contours of the tapering type of teeth have one feature in common. Starting at the cervix, these surfaces present concavities almost to the contact points, and are decidedly convex from there on to the crest of the marginal ridges. These concavities are more pronounced on the mesial than on the distal surfaces, the latter often being diverging planes. Buccolingual concavities occur frequently on the mesial surfaces of teeth having buccal and lingual roots.

The tapering type of tooth presents embrasures with greater variations in shape than do any of the other types. Incisal and labial embrasures are almost negligible. Gingival embrasures between the anterior teeth are very high and wide at the crest, while the lingual embrasures are almost the full depth of the labiolingual diameter of the crowns, and as wide as the distance from the center of one tooth to the center of its approximating one. These gingival and lingual embrasures are the largest ones to be found anywhere in the mouth. The buccal embrasures are very small. Occlusal embrasures are comparatively wide and deep. Gingival embrasures are broad and a little lower than those associated with the other types of teeth. The lingual embrasures are very long buccolingually, but diverge somewhat more than those found between teeth of the square type. (Fig. 6.)

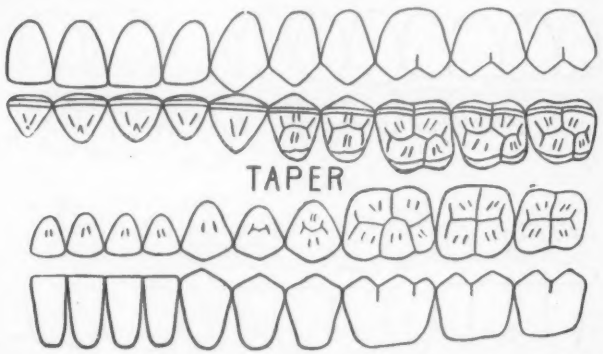

Fig. 6.—Diagrammatic tapering teeth, showing locations of contact points and shapes of embrasures.

SQUARE TYPE

The square type of tooth is bulky and angular, with little in the way of rounded contours. As the necks of these crowns are constricted very little, their proximal surfaces are almost devoid of curves. The incisor contacts are in a line with the incisal edges and extend almost to the incisal angles. These teeth are frequently in contact with their neighbors along a line instead of a point, which varies from 0.5 to 3 mm. Cuspid contacts are relatively close to the incisal edges and in a line with them labiolingually. The posterior contacts are usually found to be surfaces on the square type of teeth. As these teeth have relatively short cusps, the occlusal margin of the posterior contacts will be found in the occlusal third of the crown. The

angularity of the bicuspid and molar teeth places the buccal margins of the contacts well out onto the buccal third. The lingual extension of the contacts of the maxillary molars usually stops in the middle third, while the gingival extension is seldom more than 1 mm. in height. Mesial contacts are nearer the buccal line angles than the distal ones. Mesial contacts of the mandibular molars may measure from 1 to 4 mm. buccolingually and from a mere line to half the height of the crown occlusogingivally. They originate in the buccoclusal sector. The distal contacts originate more in a lingual direction. If they are points, they will be found at the midline of the crown in the occlusal third. If they are surfaces, they may occupy from one-third to two-thirds of the buccolingual diameter, and extend from the lower border of the marginal ridge to the cervix.

The incisal, labial, occlusal and buccal embrasures are almost nil. The gingival embrasures may be barely noticeable or may extend about one-third the height of the crown, and, when present, they are very narrow and flat. The lingual embrasures may be long or short in their lingual extensions and are found to narrow to mere slits as they approach the contacts.

Proximal contours of the square type of teeth have the tendency to become planes instead of curved surfaces. Buccolingual concavities are found at times on the mesial surfaces of the maxillary first bicuspid and first and second molars, and on the mesial surface of the mandibular first molar. The distal surfaces are generally either flat or slightly convex from the buccal to the lingual surfaces. The convexity, which goes to make up the marginal ridges, disappears at the contact, and the remainder of the surface in a gingival direction is usually rather flat. (Fig. 7.)

OVOID TYPE

The ovoid type of tooth seems to be a transitional one, between the tapering and the square types. Its surfaces are principally convex, but some are concave. The mesial contacts of the incisors are situated about one-fourth the height of the crown from the incisal edge, and slightly lingually from that edge. The distal contacts of the incisors have the same labiolingual positions, but may be found from one-third to one-half the height of the crown from the incisal edges. While ovoid posterior teeth have comparatively short cusps, it will be found that the convexity of the marginal ridges carries the contact points almost to the middle of the crown heights. The

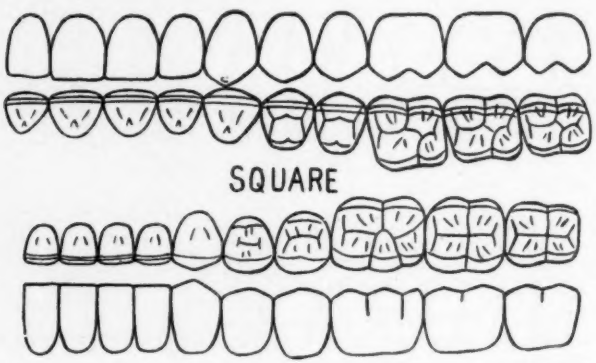

Fig. 7.—Diagrammatic square teeth, showing locations of contact points and shapes of embrasures.

prominence of the mesiobuccal cusps, coupled with the buccolingual convexity, places the mesial contacts at the junction of the buccal and middle thirds of the crowns. Buccolingually, the distal contacts are found in a line with the central grooves of the crowns. There is a tendency in all three types of teeth for the distal contacts to work in a lingual direction as one progresses farther back in the arch.

The labial, incisal and buccal embrasures situated between ovoid teeth are larger and more extensive than those found in corresponding sites in the other types. Gingival embrasures are relatively short and broad at their bases. Lingual embrasures are likewise comparatively short and broad.

Proximal contours of the anterior teeth are decidedly convex from the incisal angles to the cervix. Bicuspids of this type are frequently bell-shaped, with the convex surfaces running from the crests of the marginal ridges almost to the cervix, where they merge into slightly concave surfaces to a pleasing union with the root. The bicuspids are likewise convex from the buccal to the lingual line angles. The mesial surfaces of the molars present convex areas which are less extensive than those found on the distal surfaces. The latter are usually convex in all directions. (Fig. 8.)

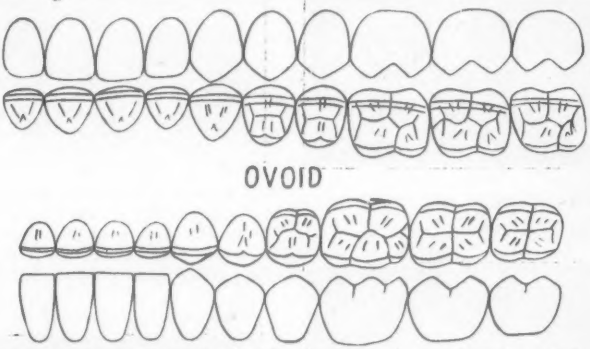

Fig. 8.—Diagrammatic ovoid teeth, showing location of contact points and shapes of embrasures.

RECONSTRUCTION CONSIDERATIONS

Ideal conditions, such as those described, are lost to some degree when the contact points wear down through abrasion. The total mesiodistal diameter of all the teeth as measured through the contacts may decrease as much as 1 cm. through abrasion. If this process is more rapid in one arch or in different parts of both arches, malocclusion, with its many ramifications, will result. Flattened contacts, with their narrowed buccal and lingual embrasures, are ideal sites for the retention of débris.

What is to be done about those worn contacts? G. V. Black[25] wrote: "If we are to provide for the future health of the teeth, with worn contacts, we must restore those flattened surfaces with points of contact." This assertion might be somewhat controversial today. Beust's evidence of the incidence of decay at the contact point indicates the necessity of restoring the contact to a point of minimum size.

What is to be done about the restoration of point contacts on those teeth which have had flat contacts ever since they assumed their positions in the dental arches? Roentgenograms show that the investing tissues have usually accommodated themselves to this condition. Bodecker states:

The crowns of teeth of old people are

relatively immune to caries. . . . Roots are frequently denuded due to lack of contour and flat contacts with proximal root caries developing. Food impaction is the external cause forcing the gingiva from the tooth cervix.

These findings seem to indicate the restoration of such teeth with point contacts. Where the flattening of contacts has forced the interseptal tissues in a buccal and lingual direction, there to be

Fig. 9.—Extreme contact and occlusal abrasion.

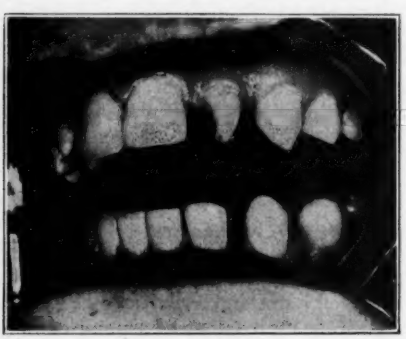

Fig. 10.—Spaced teeth having normal periodontal tissues.

irritated during mastication, these tissues have been found by clinical examination to be restored to normal color and consistency when the contact point has been rebuilt. (Fig. 9.)

Frequently, one tooth will drift into the proximal cavity of its neighbor from 1 to 3 mm., the distance depending on the depth of the cavity. These teeth can be returned to their correct functional positions, and a good cavity preparation can be made only after the teeth have been moved by slow separation or by means of an orthodontic appliance.

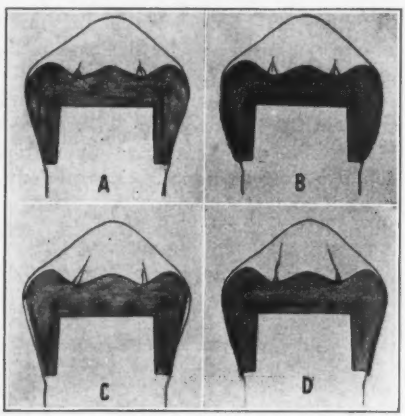

Fig. 11.—a, normal proximal contour of mesioclusodistal inlay. b, contacts dropped gingivally and contours convex. c, deficient contacts and straight proximal contours. d, protruding gingival margins that irritate tissues.

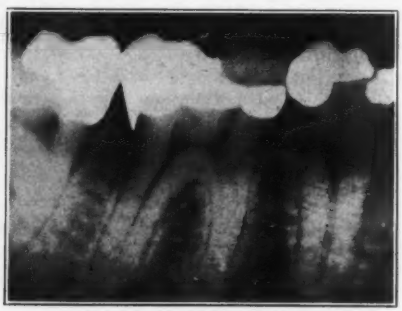

Fig. 12.—First molar having fair contour; second molar, poor contour.

When spaces normally exist between the teeth, and the investing tissues are clinically and roentgenographically normal, the best one can do is to restore a carious tooth to the contours which are

normal for that individual tooth. Nature seems to have a way of caring for some of these malformations more capably than the dentist can. Stuart[26] offered an explanation for this when he said: "Mechanical oral movements and the flow of saliva, together with expectoration and swallowing, are means of cleansing the oral cavity." The self-cleansing agencies of the mouth can function best when the contacts, proximal contours and gingival tissues are in a normal condition. (Fig. 10.)

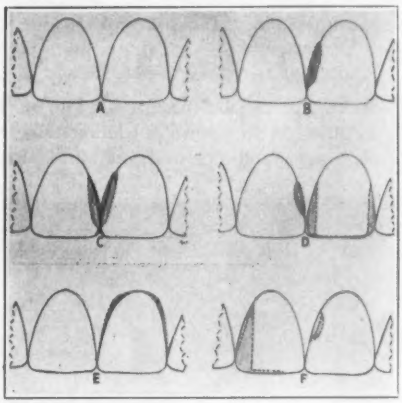

Fig. 13.—Esthetic values destroyed by incorrectly contouring proximal fillings in anterior teeth.

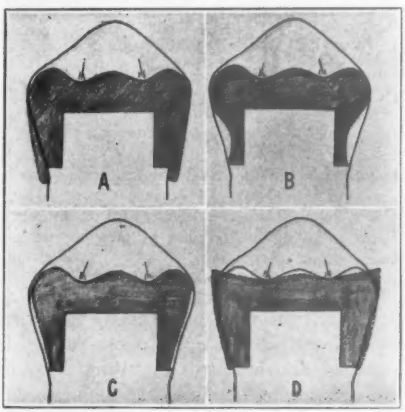

Fig. 14.—a, result of failure to use wedge to confine amalgam at gingival aspect. b, wedge protruded into cavity. c, deficient contours from adapting matrix too tightly. d, marginal ridge and contact at same site.

RESTORATION OF CONTACT AND CONTOUR GOLD INLAYS

An accurate wax pattern will restore all the lost structure so that the tooth will again have its normal contacts and contours. Sometimes, it becomes necessary to build up a contact point with

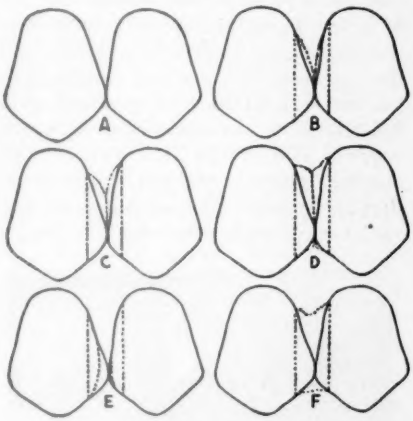

Fig. 15.—Variations in amount of interseptal space occupied by filling material (maxillary bicuspids).

Fig. 16.—Straight contours and overhanging filling showing lack of use of gingival wedges and carving instruments.

solder. Care should be taken to properly locate such a contact. (Figs. 11 and 12.)

GOLD FOIL

A properly condensed, contoured and polished foil is more compatable with the gingival tissues than any other restoration we can produce. Linen strips, when used alone to finish the proximal surface of a foil filling, will invariably leave a convex gingival margin. Gold knives and files are necessary for the correct contouring and finishing of proximal gold foil fillings. A corresponding tooth in the opposite side of the arch serves as an excellent guide in the restoration of esthetic contours. The contours of line angles can best be observed by viewing

Fig. 17.—Straight contours and overhanging filling showing lack of use of gingival wedges and carving instruments.

the restoration from the incisal aspect by the use of a mirror. Once the line angle contours are established, the proximal and labial surfaces assume their shapes very readily. (Fig. 13.)

SILICATE CEMENTS

Silicious cements tend to wash out of that portion of the cavity which extends beneath the free gum margin. They wear away rapidly when used to restore contacts, a closure of the contact resulting.

Proximal contours can be established in silicate restorations when the material is packed into the cavity in small quantities, and the matrix is adapted loosely as a confining measure. Contours are altered when matrix pressure is used to adapt the material to the cavity, as such a procedure produces a flattened surface between the labial and lingual cavity margins. Silicates can be contoured and polished reasonably well with lubricated linen strips and fine stones.

AMALGAMS

Amalgam can be manipulated in such a manner as to eliminate deficient contacts, overhanging margins and im-

Fig. 18.—Straight contours and overhanging filling showing lack of use of gingival wedges and carving instruments.

properly contoured surfaces, by following any of the accepted technics. Such difficulties are lessened by using a well-constructed matrix and a gingival wedge in proximal restorations. These appliances can be so manipulated as to provide adequate space for the full restoration of contacts and contours.

In amalgam restorations, carving and contouring are just as essential as in any other restorations. Perhaps a psychologist

can answer the following question: Why is it that the average general practitioner of dentistry will spend an hour or more glazing the tiny tissue-bearing tip of a bridge pontic and then omit the polishing of the proximal surface of an amalgam filling when that surface may have double the tissue-bearing area that the pontic had? A recent check of 2,000 proximal amalgam fillings showed that only twenty-four gave evidence that their proximal surfaces had been polished. (Figs. 14, 15, 16, 17 and 18.)

CONCLUSION

From the foregoing, we can readily understand why operative dentists have been so severely criticized by their specializing colleagues. We have some evidences of our shortcomings, our inconsistency and our inaccuracy in restoring proximal contacts and contours. Information regarding standardization of the physical shapes and locations of contacts, and of contours, has been presented in this paper that we might have some basis on which to make necessary modifications. More information is needed regarding these vulnerable areas, and these data can be gathered only by each one of us recording his individual findings.

We have been justly challenged for our failure to produce the type of dental work that we are capable of. We can meet this criticism by fully utilizing our widened knowledge and improved technics. Operative dentistry must not lag in the forward march of our profession. We must take our place in the nation-wide program of preventive dentistry.

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PROBLEM OF THE MENTALIS MUSCLE IN THE TREATMENT OF MALOCCLUSION

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THE successful treatment of malocclusion depends on the production of a normal occlusion which, with its associated conditions, forms a harmonious functioning dental unit. Not only must this condition be attained, but it also must be maintained after treatment, or failure will result. Malfunction of the facial musculature, a complication of many types of malocclusion, may be either overfunction or a lack of function of any one muscle or group of muscles. Of these conditions, the overdevelopment of the mentalis muscle is perhaps one of the most stubborn to overcome. The overdevelopment of this muscle may exist in any type of malocclusion. It is most frequently associated with those cases of malocclusion in which there is protrusion of the maxillary incisors.

Most cases of protrusion of the maxillary incisors are associated with an underdeveloped, short upper lip. These cases may be accompanied by mouth-breathing or by an open mouth habit, although some will be found in which neither habit exists.

Figure 1 shows the possible relationship of the teeth and lips in a case of malocclusion with protrusion of the maxillary incisors, which may be associated with nose breathing.

Figure 2 shows the lips of a patient having a similar malocclusion. The upper lip is short and underdeveloped because it is more or less functionless. The lower lip is thickened and rolled outward because of protrusion of the maxillary incisors. The lips of this patient can be closed only by an extreme effort, closure being accomplished mainly by an upward movement of the lower lip and little downward movement of the upper lip.

Figure 3 shows a Class I (Angle) malocclusion with protrusion of the maxillary incisors in a normal breather, although, when the lips are closed, the lower lip rests lingually from the maxillary incisors and the upper lip remains relaxed in its original position. This lip action is responsible for the protrusion, pressure being exerted upward and outward on the maxillary incisors with each act of swallowing or closure of the lips. The dimpling of the chin and the strained expression are evidence of the overuse and consequent overdevelopment of the mentalis muscle.

Figure 4 shows the lips of a girl whose maxillary teeth are too far forward in their relation to the cranium. When relaxed, the lips are parted, since a definite effort is required to close them.

In closing the lips, the lower lip is pulled upward over the teeth and the overdevelopment of the mentalis muscle becomes evident. (Fig. 5.)

Another type of malocclusion which is often complicated by overdevelopment of the mentalis muscle (Fig. 6) is that of the mouth breather. In these cases, there is usually a short, underdeveloped upper lip with an overdeveloped mentalis muscle. The action in closing the lips is similar to that just described. Whether

Read before the Section on Orthodontia at the Eighty-First Annual Session of the American Dental Association, Milwaukee, Wis., July 18, 1939.

the protrusion exists first and overdevelopment of the mentalis muscle occurs later or overdevelopment of the mentalis muscle is responsible for the protrusion, it is difficult to say. In all probability, each condition contributes to the other.

The malocclusion in Figure 7 is complicated by extreme protrusion of the maxillary incisors.

Figure 8 shows a malocclusion in its early stages. A habit of biting the lower lip was responsible for the protrusion of the maxillary incisors in this instance.

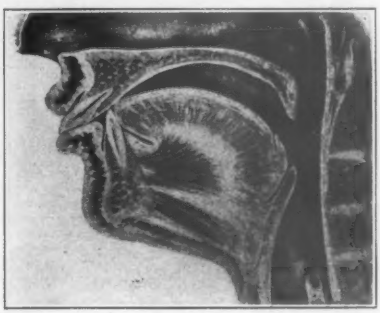

Fig. 1.—Possible relationship of teeth and lips in case of malocclusion in which there is protrusion of maxillary incisors and which may be associated with nose breathing.

Fig. 2.—Lips of normal breather whose maxillary incisors protrude between lips when latter are closed.

The action of the mentalis muscle is just beginning to be felt and the muscle is very slightly overdeveloped. Immediate treatment is indicated in this case, and as soon as the maxillary incisors are moved to their normal positions, an effort must be made to break the lip-biting habit. There is a possibility that, with malfunction of the mentalis muscle just beginning, the reduction of the protrusion may automatically eliminate the malfunction. If it does not, it will then be necessary to prescribe exercises to develop normal functioning of the lips. If nothing is done in this case, it can easily become a malocclusion that it is very difficult to treat.

Fig. 3.—Model showing occlusion of case in Figure 2; protrusion of maxillary incisors.

Fig. 4.—Case of girl who keeps lips open because of difficulty in closing them.

Figure 9 shows a Class II (Angle) malocclusion complicated by a cross-bite on the right side and protrusion of the maxillary incisors.

Figure 10 shows the case of a normal breather in which the influence of the overdeveloped mentalis muscle causes

pouting of the lips when closed. The dimpling of the chin is quite marked in this case.

These types of malocclusion are typical of those cases wherein the activity of the mentalis muscle has been a possible etiologic factor. These cases require the application of myofunctional therapy to the mentalis muscle as well as the orbicularis oris and associated muscles. If the orbicularis oris muscle remains weak after the appliances have been removed and the mentalis muscle is still exerting

Fig. 5.—Case shown in Figure 4. An effort is required to close the lips.

Fig. 6.—Lips of mouth breather.

pressure on the maxillary incisors, in all probability the occlusion will relapse to the former condition and the case will be a failure.

Figure 11 shows the occlusion of the case presented in Figures 9 and 10 after orthodontic treatment has been completed. It is now possible for the patient to close his lips without an extreme effort. (Fig. 12.)

The lips are closed in a comfortable position, and general improvement is shown. The mentolabial sulcus has improved in contour and the action of the mentalis muscle no longer causes dimpling of the chin. The general characteristics of the lips, such as size and shape and slight pouting, are still present. The prognosis of this case should be favorable.

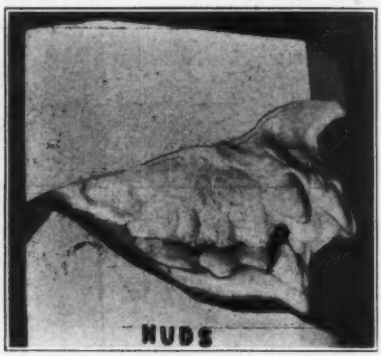

Fig. 7.—Occlusion of case shown in Figure 6; protrusion of maxillary incisors.

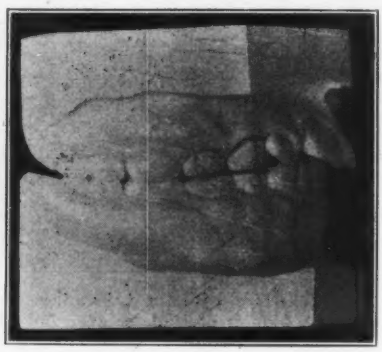

Fig. 8.—Early stages of serious malocclusion of lip biter in which influence of mentalis muscle is just beginning to be a factor.

Figure 13 shows a case in which training of the mentalis muscle will be necessary. Before treatment of this case was completed, it became necessary to discontinue treatment. Figure 14 shows the condition

of the lips at this point. The influence of the overdeveloped mentalis muscle is still present, and the case will probably return to the original condition.

A description of the mentalis muscle is necessary to appreciate its action. Because the function of the mentalis muscle is subject to much variation, the real action of the muscle has been obscured to a certain extent. Lightoller, in 1925, described this muscle and its action in detail. It is his description that is generally followed in this paper.

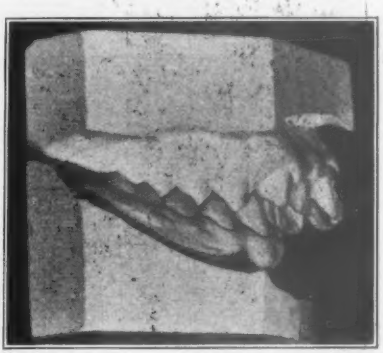

Fig. 9.—Protrusion of maxillary incisors in Class II (Angle) malocclusion.

Fig. 10.—Case shown in Figure 9. Overactivity of the mentalis muscle causes pouting of the lips when closed. There is dimpling of the chin.

The mentalis muscle (Fig. 15) arises from near the jugum of the mandibular central incisor and is inserted in the skin of the chin. (Fig. 16.)

In some cases, fibers from the muscle on each side (right and left) form loops in the center between the muscles. (Fig. 17.) These loops inclose a large pad of firm fibrous tissue below and sometimes a smaller pad of fat above this and in direct contact with it. The fibrous tissue pad is separated from the mandible by a small bursa, which permits the pad to slide over the underlying bone. When this condition exists, the chin is smooth and rounded.

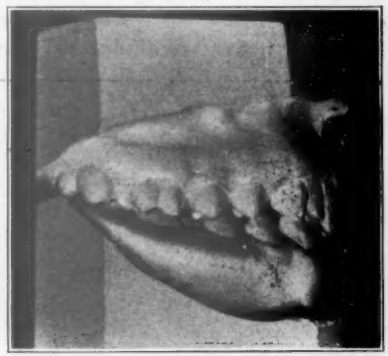

Fig. 11.—Occlusion of case shown in Figures 9 and 10; after orthodontic treatment.

Fig. 12.—Case shown in Figures 9-11; after orthodontic treatment. The lips are held together without effort.

In people with a dimpled or cleft chin, the mentalis muscle is as described by Cunningham. There are few or no median loops and all fibers of each side are inserted in the skin of the chin on the same side. The dimple or cleft of the chin is due to the skin's being bound to

and drawn inward by the fibrous tissue pad lying betwen the two muscles. In the first instance, a complete muscular cylinder exists, and, in the second instance, an incomplete muscular cylinder completed by the skin. The action of the muscle is the same in the two instances.

The two muscles, working together, form a machine similar to a double-action pump, except that the walls of the cylinder move and act as a guide for the piston, as well as furnishing the force

Fig. 13.—Lips in case needing training of mentalis muscle.

Fig. 14.—Case shown in Figure 13. The influence of the mentalis muscle, which is still present after treatment, will cause a relapse.

which moves the piston. The fibrous pad is the piston, the mobile and compressible fluid is the fatty pad and the cylinder head is formed and closed by the interlacing fibers of the orbicularis oris muscle, the quadratus labii inferioris muscle, and, occasionally, the upper fibers of the mentalis. When the muscular cylinder tries to expel its fluid contents, the pressure moves the cylinder head (the muscle of the lower lip) upward. If the upper lip is held away or is weak and flaccid, the action of the mentalis muscle pushes the lower lip upward. If the upper lip is equal in strength, the lips will be firmly pressed together. If the

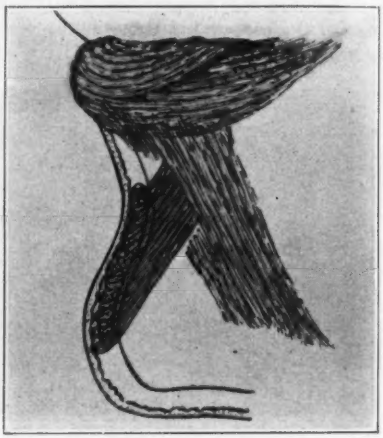

Fig. 15.—Location of mentalis muscle. (Lightoller.)

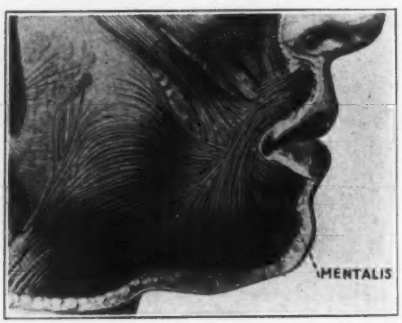

Fig. 16.—Insertion of mentalis muscle fibers in skin of chin. (Sobotta.)

orbicularis oris inferioris muscle is weak and the quadratus labii inferioris muscle strong, the lower lip will be pushed forward as well as upward. These movements are quite peculiar to the lower lip and are not possessed by the upper lip.

The action of the mentalis muscle is

different from that of any other skeletal tissue. Its activity is enhanced by raising of the skin of the chin at the same time, and its action causes small pits or depressions in the skin of the chin. (Fig. 10.) This muscular activity produces the upstroke of the engine and is the particular activity which, if excessive, causes what is called overdevelopment of the mentalis muscle, giving the orthodontist much trouble.

The opposite action, or downstroke, of the mentalis muscle is the action which should be developed in the treatment of malocclusion. This downstroke takes place when the activity of the cylinder head, formed by the orbicularis oris inferioris and the quadratus labii inferioris

Fig. 17.—Mentalis muscle. (Sobotta.)

muscles, becomes strong and forces the fatty pad and fibrous tissue pad down; which, in turn, pushes the whole cylinder wall or the mentalis downward. By the action of the quadratus labii inferioris, the cylinder is flattened against the mandible and assumes a flattened ovoid shape rather than a rounded cylindrical. This action is exemplified in the enunciation of certain consonants, such as the letter p.

The diagnosis of overdevelopment or overfunction of the mentalis muscle is comparatively simple. Observation of the chin during the closure of the lips in cases of overfunction reveals a dimpling and flattening resulting from activity of the fibers of the mentalis muscle which are inserted in the skin of the chin. The closure of the lips is accomplished almost entirely by the upward movement of the lower lip and very little downward movement of the upper lip.

The myofunctional therapy for training the mentalis muscle to function properly includes the development of the orbicularis oris and the associated muscles. The lips must be trained to function normally so that when the lips are closed, the upper lip will do its share of the work. The orbicularis oris superioris muscle must firmly resist the upward movement of the mentalis by meeting the lower lip at the proper level. Owing to the fact that, in most of these cases, the malocclusion is characterized by a protrusion of the maxillary incisors, the time that myofunctional therapy is instituted is important. The exercises should be started as soon as the protrusion has been reduced to the extent that it is possible for the patient to close the lips without an extreme effort. It must also be remembered that there are usually other factors in overdevelopment of the mentalis muscle which must have special attention. These factors are habits, such as lip-biting, abnormal function of the tongue in swallowing and mouth-breathing. All of these factors are so closely associated with the function of the mentalis that if any one is overlooked, the treatment of the mentalis muscle may fail.

There are three exercises recommended for the training of these muscles: (1) an exercise to develop the upper lip; (2) enunciation of the letter p, and (3) whistling.

EXERCISE TO DEVELOP THE UPPER LIP

The exercise to develop the upper lip, sometimes referred to as an exercise to lengthen the upper lip, was devised by Loyd S. Lourie. The procedure is as follows: 1. Grasp the chin firmly between the thumb and index finger with the lips relaxed. 2. Hold the lower lip down. 3. Close the lips. 4. Relax and repeat.

5. Repeat from ten to fifty times before meals. When the lower lip is held down as the lips are closed, the upper lip must come down to meet the lower lip. The exercise is advised before meals because this sets a definite time for the exercise, which may encourage the patient to cooperate.

THE EXERCISE OF ENUNCIATING THE LETTER P

Lightoller has pointed out the similarity of the sequence of muscle activity in enunciating the consonantal sounds b or p. The sound b may be considered as vocalized and the letter p as a nonvocalized. The muscular activity is more powerful and vigorous in enunciating the sound p. This sound may also be considered as a breath explosive labial.

The lips are in a rest position before the sound is started. Then, to begin the muscular activity, the orbicularis oris becomes active. Its origin at this moment is established by several muscles, which meet the orbicularis oris at a point just beyond the corners of the mouth. These muscles are the zygomaticus, the triangularis, the risorius and the buccinator to a certain extent. The platysma has a slight influence. The fixation of this point by this group of muscles causes the lips to be pressed tightly against the teeth all of the time without any pursing of the lips. The pressure of the lower lip is aided by the up thrust of the mentalis muscle. The downward thrust of the mentalis muscle coincides with opening of the lips to release the air pressure. The lips are held tightly together as air pressure accumulates behind them. Then the muscles which pull the lower lip down become active and weaken the closure of the lips, and the air pressure finally breaks through. All the muscles then quickly relax, and the completed sound is the vowel. It is important to note that while this is taking place, the nasalis muscle becomes increasingly active in proportion to the activity of the orbicularis oris. It is suddenly released when the air bursts through the lips, and the sudden springing open of the external nares at this moment is very striking.

Since the orbicularis oris and its associated muscles must be developed along with the training of the mentalis muscle, it would seem that an exercise involving the enunciation of the letter p would be of great value to the orthodontist. To develop normal function of the lips, mechanical exercise for one muscle will not suffice. To develop normal function, the lips should be given exercises which force the muscles to act normally. Muscles develop according to the amount of work they are given to do. Lack of work means weakened muscles, and complete lack of work means atrophy of muscles, while continued work means continued development.

The procedure of the exercise of enunciating the sound p is as follows: 1. The sound should be made forcibly. 2. It should be made before a mirror. 3. The patient should be instructed as to how to make the sound. 4. Whether the mentalis shows excessive muscular activity at the beginning of the sound must be noted. 5. Two exercise periods of five or ten minutes each must be observed daily. 6. The patient may be instructed to exercise at any other convenient time if the mirror is not available. To make the exercise more interesting to the patient, some variation may be advisable. The letter p may be combined with the different vowels, as one variation. Since the muscular activity in making the sound b is similar, but slightly less forceful, the following jingle may be given:

Betty Botta bought some butter,
But she said, "This butter's bitter.
If I put it in my batter,
It will make my batter bitter."
But a bit of better butter
Would but make my batter better.
So she bought a bit of butter
Better than the bitter butter
Made her bitter batter better.

So 'twas well that Betty Botta
Bought a bit of better butter.

or:

Peter Piper picked a peck of pickled peppers.
A peck of pickled peppers Peter Piper picked.
If Peter Piper picked a peck of pickled peppers
Where are the pickled peppers Peter Piper picked?

These two exercises must be said slowly with each b or p spoken forcibly.

Cornet instruction should not be overlooked, since the muscular activity involved in playing a cornet or any similar instrument is very valuable in training and developing this group of muscles.

WHISTLING

Whistling is nothing more than a continuous non-vocalized consonantal sound. It is a "high explosive" consonant. This exercise is an exceptionally fine exercise for the orbicularis oris and the associated muscles, and for the mentalis as well. The down stroke of the mentalis muscle seems to be exceptionally prominent in this muscular activity. The muscular activity is much more vigorous and powerful than that used in making the sound p.

It will usually be necessary to teach the patient to whistle, for most persons with extreme protrusion are unable to whistle. It is important that the patient purse the lips and that he be carefully instructed and supervised while learning to whistle so that the muscular activity may be used to the greatest advantage.

As has been said, in many cases training of the mentalis is necessary because of mouth breathing or an open mouth habit, and it is characteristic of these cases that the alae of the nose are much underdeveloped because of lack of function. It is important to note that in whistling, the nasalis muscle is very active, and this activity is directly proportional to the activity of the orbicularis oris muscle. Therefore, the patient should be encouraged to whistle the scale and to practice to increase the range of high notes. The higher the note, the greater the muscular activity. The increased muscular activity of the muscles controlling the alae of the nose may be detected by placing the finger and thumb on the alae as the scale is whistled.

One other observation that must be made of the whistling exercise is that, in whistling, the pterygoids are also exercised because, in order to whistle, it is necessary to move the mandible forward.

The value of whistling lies in the fact that it exercises many of the muscles involved in the myofunctional therapy indicated in the treatment of Class II malocclusion, and that it is especially valuable, when done correctly, in the training of the overdeveloped mentalis muscle. Also, cooperation of the patient is much easier to obtain because the exercise is much more interesting than the average muscle exercise.

These exercises have been suggested in the belief that the best exercise for any group of muscles is the normal work of that particular group and that all muscle tissue continues to develop when given normal work.

CONCLUSIONS

1. It is difficult to overcome overfunction of the mentalis muscle.

2. Overfunction of the mentalis muscle is most frequently associated with those cases of malocclusion showing protrusion of the maxillary incisors.

3. Overfunction of the mentalis is often associated with lack of development of the orbicularis oris and associated muscles.

4. If malfunction of these muscles has not been overcome, when the retaining appliances are removed a relapse to the former occlusion is likely to occur.

5. Overfunction of the mentalis muscle is shown by dimpling and flattening of the chin when the lips are closed.

6. Myofunctional therapy is indicated

when the maxillary incisors have been moved lingually so that the lips may be closed with less effort.

7. Exercises which give the muscles normal work are preferable in myofunctional therapy.

8. The exercises recommended for the training of the mentalis muscle and the development of the associated muscles important to the normal function of the mentalis muscle are: (a) an exercise to develop the upper lip; (b) enunciation of the letter p, and (c) whistling.

9. Whistling is an exceptionally valuable exercise for the orbicularis oris, the mentalis, the pterygoids and the nasalis muscles.

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"THERAPEUTIC ODONTOTOMY" AND "PREVENTIVE DENTISTRY"

By HENRY KLEIN,* D.D.S., and CARROLL E. PALMER,† M.D., Washington, D. C.

TWO main procedures now used in clinical dental practice for the control of caries are (1) prophylactic odontotomy and (2) the placement of fillings in areas of teeth from which carious débris has been removed. The first of these methods involves the removal of the caries-susceptible but caries-free area from the mouth before an attack by caries can take place. In the application of this technic, the tooth areas liable to decay are surgically removed and then replaced by materials impervious to disintegration. According to the usual practice, this method is restricted, in the main, to the occlusal surfaces of the molar teeth. In a somewhat parallel manner, the second procedure (the treatment of an area with existing caries) includes the amputation of the lesion, extension of the operation to self-cleansing areas of the affected tooth (the well-known concept of "extension for prevention" of Black) and the restoration of the original tooth form by the highly developed technical procedures of operative dentistry.[1] It is apparent that both these methods are predicated on the surgical removal of either the caries-susceptible or the actual carious area from the environment in which risk of attack by caries exists and replacement by non-reactive filling materials.

It is clear that these procedures are of the greatest significance in the maintenance of optimal dental health. It is desirable to recognize, however, that both represent attempts to control a disease the cause of which is obscure. Thus, were a complete knowledge of the etiology of caries available, true prevention of carious lesions would in all likelihood be assured without amputation of tooth substance. From this point of view, therefore, the application of the clinical control methods

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discussed above constitutes, rather than prevention *per se*, circumvention of caries in the first instance, and therapeusis of caries in the second; each of these objectives being achieved by essentially the same technic (surgical removal and filling). Thus, the amputation of an area of a tooth and its restoration by fillings, before a caries attack takes place, has the meaning implied by Hyatt[2] in his term "prophylactic odontotomy."[3] In a parallel manner, the eradication of an area of existing caries and the restoration of the original form of the tooth by filling becomes "therapeutic odontotomy," an expression which may be viewed as designating those clinical procedures which are concerned with the treatment of caries through the process of cutting out the carious area and replacing the lost tooth substance with filling materials. (Although it is recognized that other and more complete designations might be developed to carry the meaning intended—for example, neither term, prophylactic or therapeutic odontotomy, conveys the fact that fillings form an integral part of the technics—the parallelism between the two procedures would appear to justify a consideration of the term "therapeutic odontotomy.")

In many respects, prophylactic odontotomy approaches a preventive measure. Thus, in the application of this technic, caries has been found to be effectively prevented in the area treated. Preventive objectives are achieved also by therapeutic odontotomy, since fillings, if properly placed, generally terminate the carious process in the affected surfaces and prevent the extension of the lesions to other adjoining tooth areas or into the vital pulp. It is clear that both of these clinical methods possess some prophylactic attributes, yet, in a strict sense, they do not appear to constitute measures which prevent the initiation of caries.

It is generally recognized that the problem of preventing the initiation of caries will largely be solved when the etiology of this disease becomes known. By this rather strict definition, the prevention of the initiation of caries remains, at the present time, largely an unsolved problem in spite of the existence of a considerable number of theories accounting for the inception of attack by this unique disease and in spite of procedures variously advocated for its prevention. Thus, the population likely to experience caries (and these include 90 per cent of the children of grade and high school age) are confronted with the fact that no undisputed method is available which can be depended on to prevent the initiation of carious lesions in the susceptible areas of the teeth.

On the basis of the considerations here discussed, preventive dentistry represents, at the present time, perhaps more an objective than an accomplished fact. The clarification of terms here attempted would appear to render this essential differentiation more apparent. The use of the terms "prophylactic odontotomy" and "therapeutic odontotomy" to designate, respectively, the avoidance of caries attack and the arrest of existing caries by a removing and filling mechanism leaves available, and free from ambiguity, the expression "preventive dentistry" for designating those procedures which research may be expected to develop for the purpose of preventing, precisely, the initiation of caries. Methods which may be developed for the prevention of other specific dental diseases obviously would be included also within the meaning of preventive dentistry.

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RED MARROW IN THE JAWS

By Lester R. Cahn, D.D.S., New York, N. Y.

LITTLE attention has been paid to the presence of red marrow in the jaws or to its significance. Aside from the two communications by Box, there has been no contribution in English, nor in any other language as far as I can find, devoted entirely to this important subject.

There are two normal types of bone marrow, the red, or hematopoietic, marrow; and the yellow, or fatty, marrow, which has no blood-forming function. At birth, and in early childhood, red marrow prevails, but, as age advances, yellow marrow displaces red until, in the normal adult, red marrow is found only in the ends of the shafts of the long bones, such as the femur and humerus, in the ribs, sternum, bodies of the vertebrae and cranial diploe. Although fatty marrow has no blood cell-forming function, there are always present a number of hematopoietic cells that can rapidly proliferate under stimulation and transform the yellow into red marrow.

The jaws, in most instances, contain yellow marrow. (Fig. 1.)

Box observed that in 100 blocks of human jaw tissue, yellow marrow was seen in seventy-five, while red was found in twenty. He was convinced that "even in early adult life, the bone marrow in the average normal case is of the fatty or yellow variety."

In routine examination of material sent to the laboratory of oral pathology at the Columbia University Dental School, I have rarely found red marrow. It is found mostly in the maxillary and mandibular molar and bicuspid regions.

The red blood cells, granulocytes and platelets are formed in the red marrow. The forerunner of these cells is a reticular cell, to which are attached fibers that can be stained with silver. These cells, together with their interlacing fibers, are part of the reticulo-endothelial system and form the stroma of the marrow. From the reticular cells, there develops the hemocytoblast, which, in a proper environment, may form in the marrow, granulocytes, erythrocytes or megakaryocytes. The reticulo-endothelial system is intimately connected with the defense mechanism of the body.

The function of the red blood cell, by virtue of its hemoglobin content, is to carry oxygen from the lungs to the tissues. If disease has rendered the lungs incapable of utilizing the normal oxygen in the air, or if the atmosphere is rarefied, there occurs a lowered oxygen tension in the blood, which results in a functional demand for more red cells. This, in turn, will cause a hyperplasia of the red marrow.

An increase in the number of erythrocytes, with possible red marrow hyperplasia, may be found in those living in high altitudes where the air is rarefied, and in those in whom the lung tissue has become so diseased and altered that the normal amount of atmospheric oxygen cannot be fully utilized. This condition may occasionally be seen in emphysema, lung tumor and pulmonary tuberculosis.

It may also be found in congenital

Read before the International Association for Dental Research, Philadelphia, Pa., March 14, 1940.

From the Division of Oral Pathology, School of Dental and Oral Surgery, Columbia University.

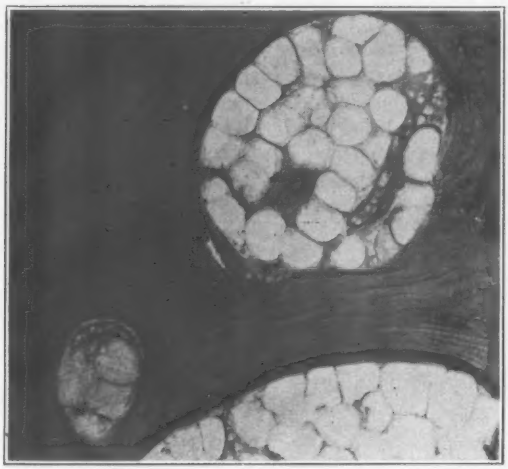

Fig. 1.—Yellow or fatty marrow. This is the type most commonly found in the jaws. A few hematopoietic cells are always present, and these, under proper stimulation, can proliferate; which transforms this kind of marrow into the red variety.

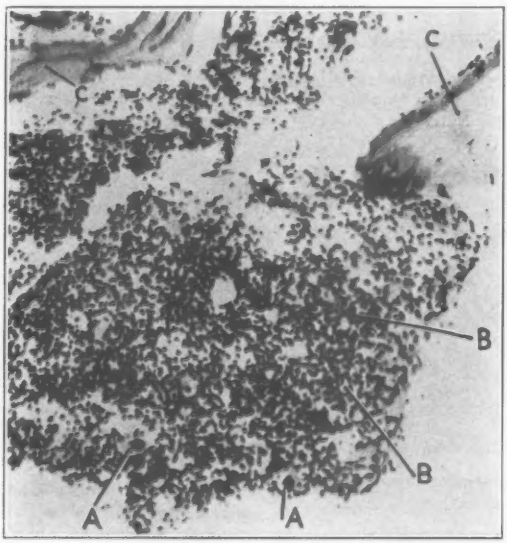

Fig. 2.—Red marrow in maxillary molar area. There is resorption of the trabeculae and one can note the erosion of the trabecular surface. This is to be compared with the surfaces of the bone in contact with the yellow marrow, seen in the previous picture. A, megakaryocytes. B, hematopoietic cells. C, trabecula.

heart disease, and in Ayerza's disease when the flow of blood to and through the lung is diminished and proper oxygenation of the blood is prevented.

Chronic poisoning by carbon monoxide and other chemicals may bring about similar marrow and hematologic changes, as will slight repeated hemorrhage.

nuclear leukocyte, is defense against microbic invasion.

An increase in the number of granulocytes, with red marrow hyperplasia, may be found in severe infections. Those infections that have a leukoblastic response will undoubtedly stimulate the activity of the reticulo-endothelial system.

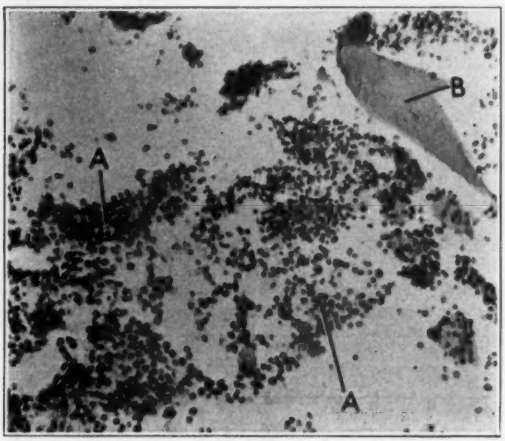

Fig. 3.—Red marrow in the mandibular molar region. There is a paucity of trabeculae. In this specimen, there are a large number of eosinophilic hematopoietic cells, but no megakaryocytes. A, hematopoietic cells.

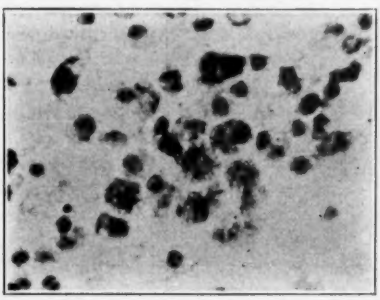

Fig. 4.—Higher magnification of Figure 3, showing eosinophilic cells.

Fig. 5.—Roentgenogram of mandibular molar area of woman suffering from pulmonary tuberculosis. There is a paucity of trabeculae and a large amount of soft tissue, which is red marrow.

In pernicious anemia, the red marrow becomes hyperplastic owing to a reversion of the marrow to formation of a primitive type of red cell.

The function of the granulocytes, the principal cell being the polymorpho-

This may also account for the marrow hyperplasia.

Myelogenous, monocytic and lym-

phatic leukemia will likewise cause an increase in the amount of hematopoietic marrow.

It has been noted that where there is an increase in the amount of red marrow, rarefaction of the surrounding bone takes place. This is a compensatory reaction on the part of the bone, to make room for the increased number of cells.

What is the connection between the presence of the red marrow in the jaws and the foregoing? We have seen that red marrow occurs very rarely in the jaws of the normal adult. When it is found, it is vestigial.

Red marrow in the jaws (Figs. 2 and 3) is, in most instances, a response either to a local infection or to some general

Fig. 6.—Cellular marrow in jaw of tuberculous person. Undoubtedly, a section of the area shown in Figure 4 would disclose the same histologic picture. (From Orban.)

disturbance that is stimulating hematopoietic depots in other parts of the body. What the stimulating factor is can be found only on investigation.

A number of years ago, I noted that in some tuberculous patients, there were characteristically large intertrabecular spaces (Fig. 5), especially in the mandibular molar regions. At that time, I did not know what had filled these spaces. Very little if any attention was ever paid to these observations and I have never seen any reference to this subject, except once, when Orban, in a paper on traumatic occlusion, described a specimen that he had sectioned. He said:

The bone trabeculae of the jaw between the bicuspid and the molar are few and thin. The marrow is rich in cells (Fig. 6). It is not the typical fatty marrow, but it contains many cells of the blood building marrow. The marasmic condition of the tuberculous individual may account for this finding, and also for the atrophic condition of the bone.

We have since learned that these inter-

Fig. 7.—Roentgenogram of area from which section shown in Figure 2 was made. It is difficult to distinguish this picture from one of periapical osteitis, yet, as a matter of fact, there was little inflammatory tissue present. It would appear that development of this cellular marrow was a response to the infection about the teeth.

Fig. 8.—Roentgenogram of area in which section shown in Figure 3 was made. This rarefied zone (arrow) may be mistaken for an area of infection. The general history of this patient was unknown.

trabecular spaces are filled with red marrow, and we have observed that erythroblastic stimulation resulting in red marrow hyperplasia may take place in pulmonary tuberculosis. It does not always occur, for there may be enough healthy lung tissue to normally oxygenate the blood. However, the presence of these

spaces should prompt one to investigate further.

Likewise, other systemic conditions that can initiate either an erythroblastic or leukoblastic reaction may produce similar pictures in the jaw.

Local infection may stimulate the regional reticulo-endothelial structures in the marrow, with a circumscribed hematopoietic cellular response.

It is of great importance to be able to recognize these foci of red marrow. Box has been the only one who has called attention to the possible misinterpretation of the roentgenographic picture. When we realize that an increase in the red marrow causes rarefaction of the bone, we can readily see that a confusing radiolucent area might result (Figs. 7 and 8), which could be mistaken for an area of infection and might be needlessly operated upon.

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SIX DIFFERENT KINDS OF OVERBITES

By SHERWOOD R. STEADMAN, B.S., D.D.S., M.S., St. Paul, Minn.

An overbite is here considered to be any arrangement of the teeth in which the upper central and lateral incisors overlap the lower incisors, whether or not an overjet is present. In Figure 1, cases A and B both show overbite. B also shows an overjet. In A, there is no overjet.

Only cases of permanent dentition before the eruption of the third molars will be considered, leaving adult and mixed dentitions until later.

Photographs are not used, since growth and development during correction tend to obliterate the changes in the face due to changes in the overbite.

The curve of Spee referred to will be the plane joining the tips of the buccal cusps of the first molars (and second molars, if fully erupted), the bicuspids, cuspid tip and incisal edges of the lateral and central incisors. The distobuccal cusp of the upper first molar is disregarded since it may normally extend below this plane. The articular surface of the condyle, to which Count Spee also referred, I shall omit entirely, and the curve of Spee will mean only the plane joining the tips of the cusps and incisal edges. Thus, any dentition or pair of models presents four curves of Spee: upper right and left and lower right and left.

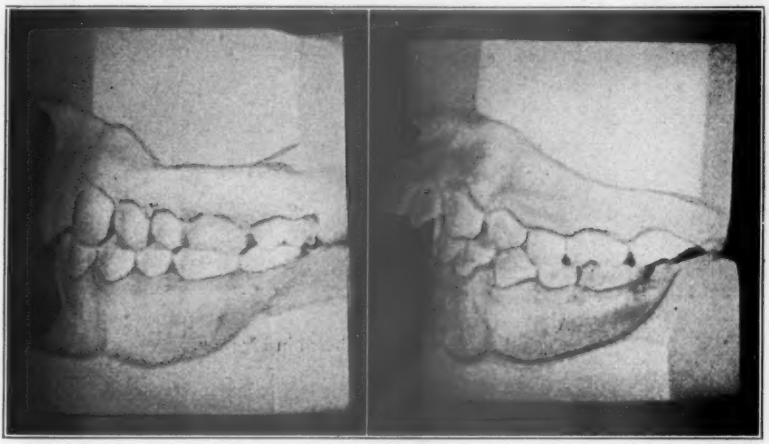
Much is said these days about overbites and their treatment in orthodontic cases. There is no little argument as to the advisability of bite-plates, bite-planes, cement blocks on posterior teeth and similar means of propping open the bite so that the incisors overlap to the satis-

Read before the Section on Orthodontia at the Eighty-First Annual Session of the American Dental Association, Milwaukee, Wis., July 19, 1939.

faction of the orthodontist, who thereupon attempts to find some means for holding the teeth and jaws in this strained position.

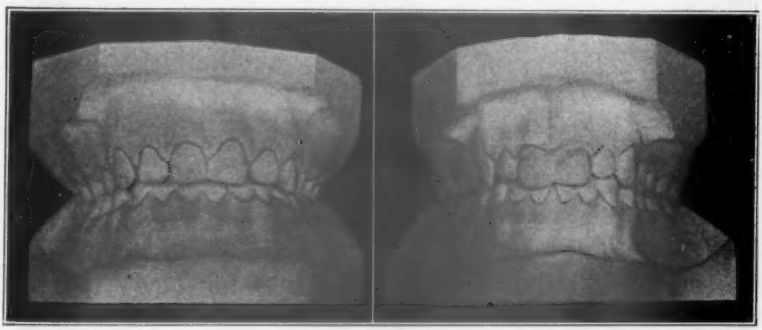
Let us state now that those using the edgewise arch with bicuspids banded find the difficulties presented by abnormal overbites automatically met in their treatment with the placing of advisable curves of Spee in their upper and lower ideal arches after bracket control has been established. Thus, there is little for them to consider from the standpoint of treatment, but, in the diagnosis of their cases, serious attention should be given to the curve of Spee so that well-treated cases will be maintained in the well-treated state.

As has been intimated, the solution of an overbite case lies in diagnosis of the overbite, which means curves of Spee, both upper and lower. For example, Figure 2 shows two models having excessive overbites of about the same degree. "Since the overbites are the same, it should be possible to correct them in the same manner" is a common, though fallacious, way of reasoning. Therefore, let



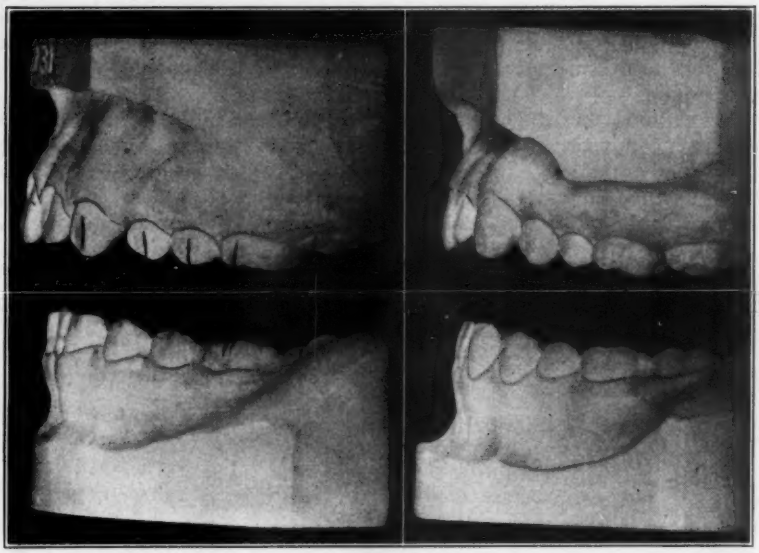
A B

Fig. 1.—A, overbite, no overjet. B, overbite and overjet.



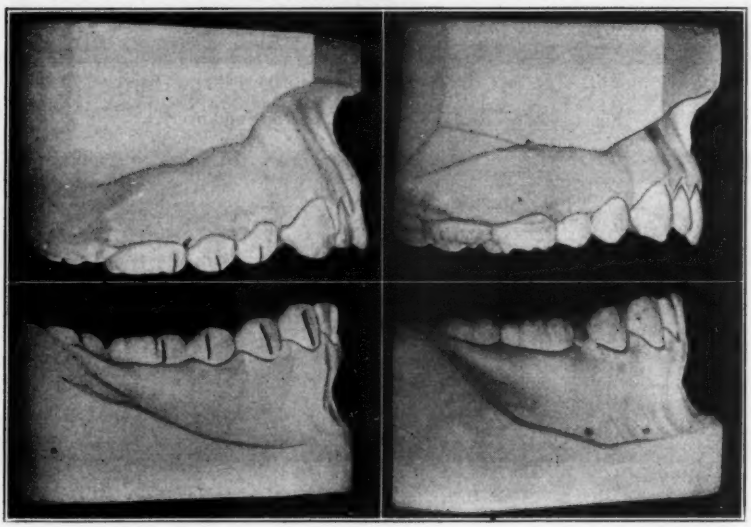
A B

Fig. 2.—Excessive overbite.



A B

Fig. 3.—Left sides of cases shown in Figure 2.



A B

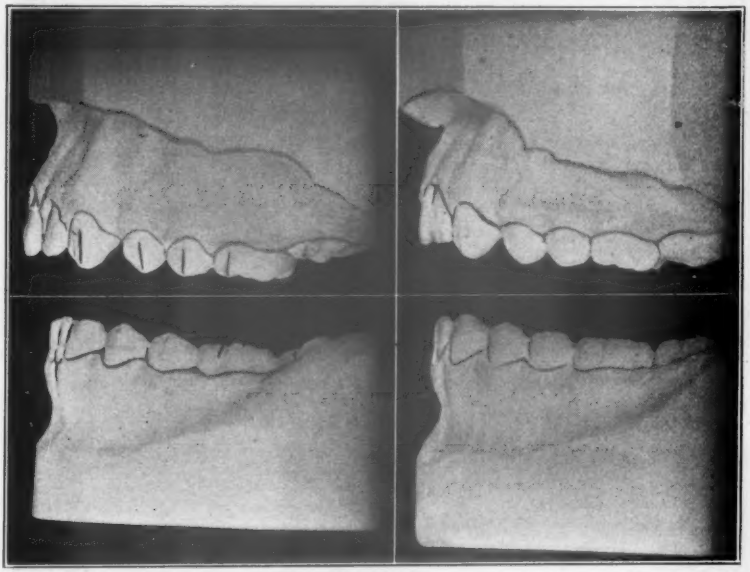
Fig. 4.—Right sides of cases shown in Figure 2.

us analyze these cases from the standpoint of the curve of Spee in order to establish a logical basis for reasoning and diagnosis. Figure 3, showing the left sides, presents advisable upper and lower curves of Spee. The two cases are alike

except for the upper central incisors of the model on the right (B), which overhang. It is difficult to place the upper central incisors in a definite position with regard to the curve of Spee, since the elongation seems extremely variable in different cases, although the curves of Spee may seem identical and advisable. There probably is some direct correlation with the height of cusps and tooth form.

Considering the curves of Spee on the right sides of these models in Figure 4, we discover the first difference between them: "A" has an excessive lower curve of Spee, while "B" seems acceptable. In the upper, "A" is slightly irregular, but still advisable, while "B" has a reverse upper curve of Spee. Thus, the diagnosis of the overbites of A and B, as determined by these four respective curves of Spee, shows them to be very different even though the degree of overbite is the same. The left sides are alike and normal; the right sides just the opposite; yet their overbites look identical.

Correction based on this curve of Spee diagnosis would consist in restoring an advisable curve of Spee to the lower right side of A and upper right side of B. When this was accomplished, the overbites were restored in an advisable degree. The right side of A had to be changed from a developing Class II to a full Class I in order to correct the articulation; and, in B, the upper central incisors were depressed 1 mm. and room was made for the lower right second bicuspid without changing the advisable curve of Spee originally present.

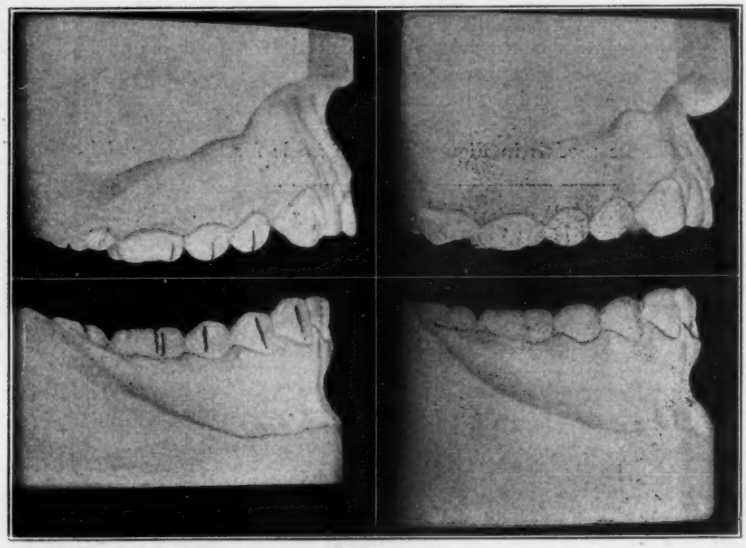


A B

Fig. 5.—Left side of Figure 2 A, before and after correction.

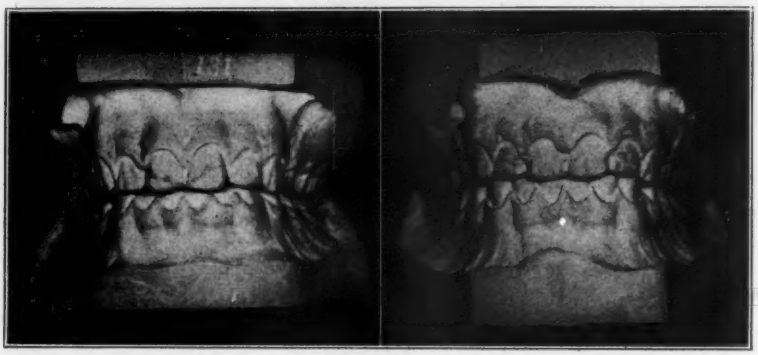
Figure 5 shows the left sides of A before treatment and their advisable curves of Spee unchanged after treatment. Figure 6 shows the right sides of A before and after correction with the upper unchanged and the lower curve of Spee changed from an excessive one to a more advisable flattened one. Figure 7 shows how the flattening of the lower left curve of Spee has changed this excessive overbite to a more advisable one.

Similarly with 2 B: Figure 8 shows the left sides unchanged by treatment except for the depression of the upper left central incisor by 1 mm. Figure 9 shows the right side with the lower curve of Spee unchanged and the lower right second bicuspid in place, while the upper curve of Spee has been changed from a reverse curve to a more advisable curve of Spee and the right upper central incisor also has been depressed 1 mm. Figure 10 shows how this changing of the upper right curve of Spee reduced the overbite an advisable degree, with the upper lateral incisors as a guide because the upper central incisors were depressed 1 mm. during treatment and so do not serve as an accurate guide of the change



A B

Fig. 6.—Right side of Figure 2 A, before and after correction.



A B

Fig. 7.—Front view of Figure 2 A, before and after correction.

in overbite shown unless this depression is taken into consideration.

Thus, the overbites of A and B were cared for by correcting one curve of Spee in each case (plus, of course, correction of alinement and Class I relationship). The use of bite-plates, bite-planes, cement blocks and the like are contraindicated unless an identical change could be produced only in each of these two faulty curves of Spee, and just where needed, without alteration of any of the other curves of Spee.

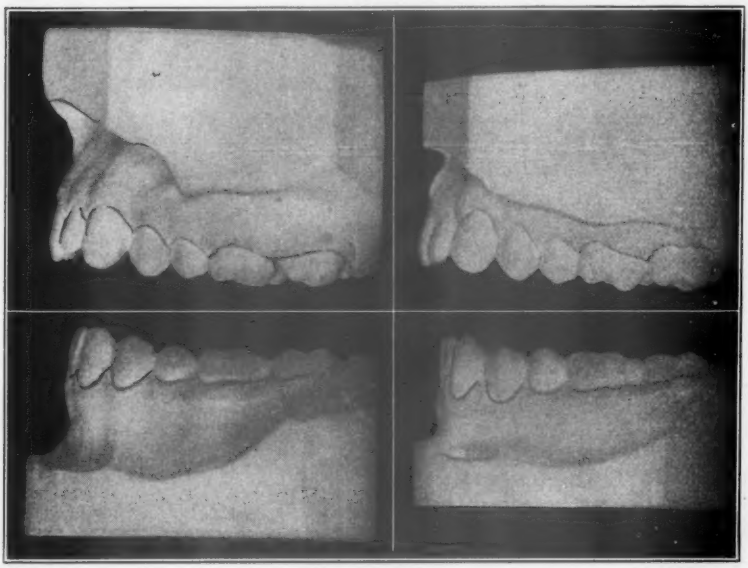
This raises the question as to just how many different kinds of curves of Spee there are and what their combination is.

Generally speaking, a curve of Spee can be of four types: (1) advisable; (2) excessive; (3) flat and (4) reversed.

On the chart, Figure 11, there are altogether sixteen different varieties of curves of Spee. The infinite number of intermediate possibilities are not shown. For common consideration, column 4 can be eliminated because reverse lower curves of Spee are a rarity.

1 a, 2 b, 3 c, and 4 d will all give advisable overbites, but only 1 a presents an advisable curve of Spee. 2 b and 3 c and 4 d should be corrected to advisable curves of Spee even though their overbites seem acceptable, because function will probably be abnormal otherwise, unless tooth form is unusual.

Excessive overbite results from curves of Spee such as those in 1 c, d, 2 a, c, d and 3 d; while open bites result from 1 b, 3 a and b, and 4 a, b, c.



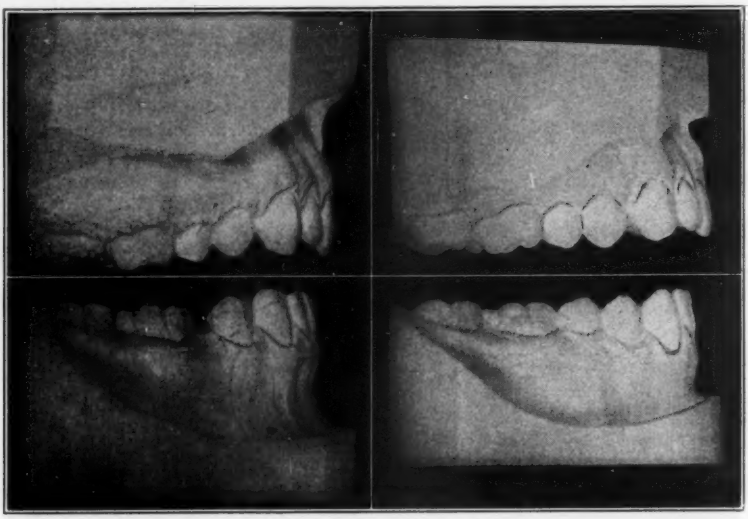
A B

Fig. 8.—Left side of Figure 2 B, before and after correction.

So much for the different types of curves of Spee and overbites.

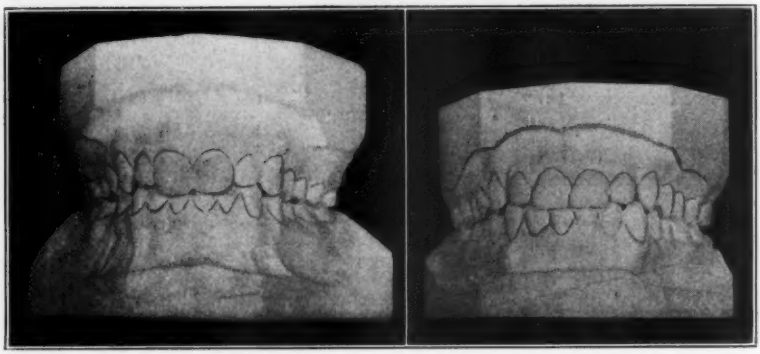
Class II and Class III relationships may change the overbite presented by a set of curves of Spee by tipping the curve up or down with relation to the plane of occlusion. Suffice it to know this may occur and to be on guard for the variations when presented. Correction of the curve of Spee, however, will correct the

overbite only if the Class II or Class III relationship is reduced to Class I, and alinement is perfect. Correction of the curves of Spee gives an advisable overbite, just as correction of a Class II to a Class I eliminates overjet.



A B

Fig. 9.—Right side of Figure 2 B, before and after correction.



A B

Figure 10.—Front view of Figure 2 B, before and after correction.

A tongue habit or lack of vertical growth in some area, such as the premaxilla, may tip an advisable upper curve of Spee so as to result in an open bite. Vertical elastics have corrected this, and no retention is needed so long as the tongue habit remains broken.

TREATMENT AND MECHANICS

In Figure 6, the lower curve of Spee had to be changed. It is evident that the curve of Spee has been flattened. The clearest way to describe what has occurred is to say that the two bicuspid

teeth have been elevated. Eruption cannot be counted upon to accomplish this even though it does sometimes do so where there is plenty of room for both bicuspids between molar and cuspid. In this particular case, there is the same distance from molar to cuspid on both sides before and after treatment; yet this side has an excessive curve of Spee, while the other does not. Thus, mechanical force must be employed to elevate these bicuspids, or depress molar, cuspid and incisors, or both, to place. In other words, it will be necessary to use the molar, cuspid and incisors (central and lateral) as anchorage to pull the bicuspids up to their correct height. Whether the molar, cuspid and incisors are depressed is of not much concern for the present. However, elevation is one of the easiest of tooth movements and depression one of the most difficult, especially in molars and cuspids; and so, until such time as there is definite proof from properly controlled lateral cephalometric appraisal, one might be permitted to assume that probably elevation of the bicuspids is in fact what takes place.

Similarly, in Figure 9, the upper bicuspid teeth had to be elevated to change the reverse upper curve of Spee to the desirable form. These cases were treated with the edgewise arch mechanism employing ideal arches with all teeth banded from first molar through first molar. Any mechanism can accomplish this if properly handled, just as long as it is so arranged that it is braced on the molars, cuspids and anterior teeth to pull the bicuspids up or down into the desired curve of Spee.

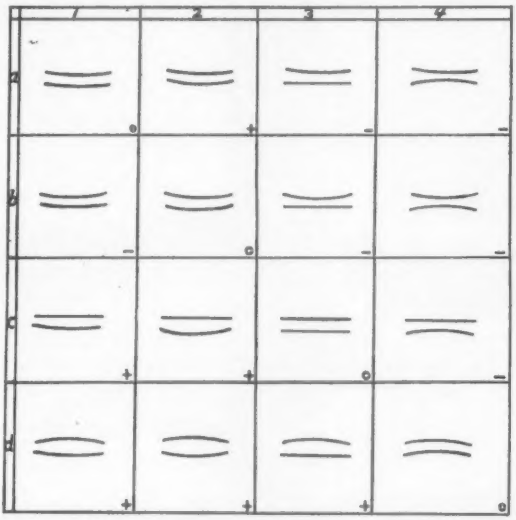


Fig. 11.—Column 1, advisable lower curves of Spee; 2, excessive lower curves; 3, flat lower curves; 4, reverse lower curves. Row a, advisable upper curves; b, excessive upper curves; c, flat upper curves; d, reverse upper curves.

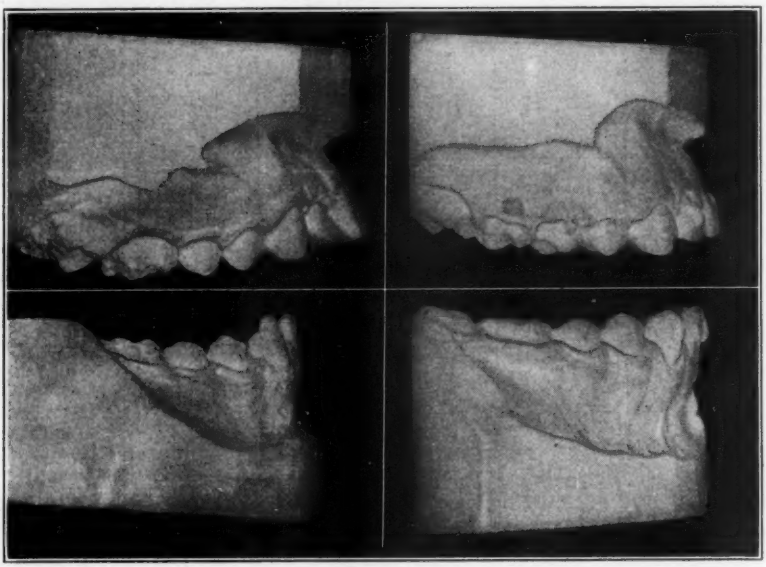
Figure 12 presents a different picture. Here, the lower anterior teeth seem elongated rather than the bicuspids unerupted. What actually occurs during treatment remains to be seen from properly controlled cephalometric appraisal. Suffice it to say that, in the treatment of this case, the lower incisors seemed to be not only tipped forward, but also moved bodily somewhat forward, as well as depressed, as shown. Also, there was some

elevation of the bicuspids, while the cuspid seemed more or less stationary in the vertical plane of space. The result was a flattening of the curve of Spee together with alinement of the teeth. In the upper jaw, the curve of Spee was but slightly changed; which was mostly due to the great change in arch form required. Second order bends with elastics reduced the Class II relationship to a Class I. Figure 13 shows the similar changes on the left side.

The resulting overbite is nearly end-to-end in Figure 14. This lack of overbite is desirable in this type of case to allow the teeth to settle to their own overbite through function while being retained for rotation and arch form.

Thus, treatment varies with each case, depending on which teeth must be depressed or elevated. The requirements seem to be correction of arch form, arch length and rotation; reduction of the case to a Class I relationship, and changing of the curves of Spee to the desired shapes. The advantage of the edgewise arch mechanism is that it accomplishes all of these movements simultaneously, when properly handled, except for the second order bends, which generally must wait upon alinement, but not always.

To sum up treatment: It is evident that certain teeth must be elevated to the desired curve of Spee and that others may have to be depressed. We cannot wait for the natural force of eruption to accomplish this elevation because we do not know when it will occur and perhaps it will not. Thus, there remains only one thing for us to do, and that is to use certain teeth as anchorage and pull the others either up or down to the desired curve of Spee. This means taking hold of the teeth individually; which involves the use of bands. Whether we use the edgewise arch is immaterial. The important thing is to plan the forces in whatever appliance we may be using, so as to elevate or depress, wherever needed, to the desired curve of Spee. If the curve of



A B

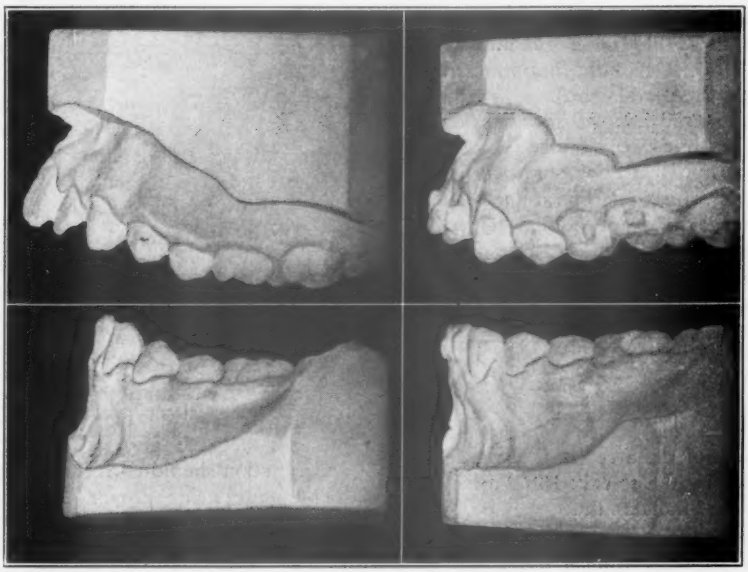
Fig. 12.—Condition before and after correction.

Spee is correct, the teeth are in alinement, and a Class I case is established, the overbite will be corrected and automatically. So much for treatment and mechanics.

A and B, Figure 14, show models made before and after correction. The side view before correction is shown in Figure 1 B.

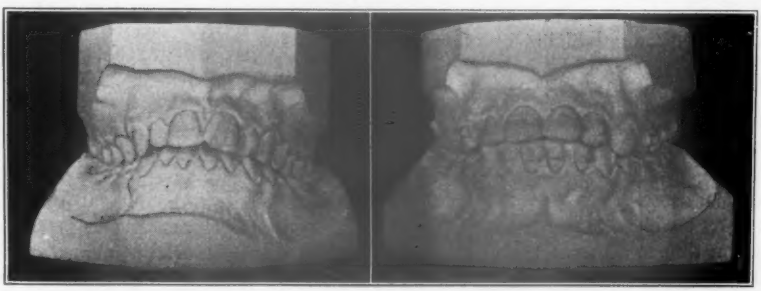
MIXED DENTITIONS

In mixed dentitions, overbites, as such, should be disregarded. If the lower incisors are so crowded or a Class II relation so bad that the lower incisors are injuring the palatal tissues and interfering by soreness with eating and mastication, measures should be taken to correct the alinement and reduce the Class II



A B

Fig. 13.—Condition before and after correction.



A B

Fig. 14.—Front view of Figures 12 and 13, before and after correction.

relationship to a Class I; which will automatically correct the overbite to such an extent that eating and mastication no longer will be interfered with.

The presence of the deciduous molars and cuspids upsets any plans for correcting overbite in a mixed dentition. The permanent incisors and molars are larger than the deciduous teeth in all respects. The deciduous molars required only a small overbite of the deciduous incisors. When the permanent incisors, which are much larger than the deciduous, do come in, they must work beside deciduous molars; which, of course, results in an excessive overbite. The mixed dentition seems to be a transitional stage, and it therefore cannot be expected to have an overbite such as is presented by a full permanent or full deciduous dentition, in which all of the teeth are large or small, respectively.

When the deciduous buccal segments are shed and the bicuspid and cuspid teeth do erupt, there also is some vertical growth of the alveolar process, definitely shown by the so-called "submerged" deciduous molars that are occasionally found.

Overbite, as such, in a mixed dentition should therefore cause no concern; but this does not mean that poor alinement, lack of spacing and other manifestations of lack of growth and development or faulty eruption should not be corrected.

ADULTS

Excessive overbite in adults (people over 20 years of age, in whom growth and development, as we consider them, have ceased) is of two general classes. In the first, there is loss of the vertical dimension due to wear or loss of teeth, or both. At one time, there was a desirable overbite in these cases. This class must have the curves of Spee restored by some means which is not orthodontic, and so they can be disregarded here. In the second class, there never has been a normal overbite, owing to faulty curves of Spee and associated malocclusion. In these cases, overbite can be corrected if the curves of Spee can be corrected by orthodontic means. Of course, the abnormal wear on the cusps will make retention difficult. Also, there is no developmental growth during treatment. Furthermore, there is the slowness of response which increases with age; yet the curves of Spee sometimes can be corrected for this class of adults.

Then too, there is the combination of these two classes, which I shall merely mention, since this is simply a mixture of the conditions presented by the two classes of adults above described.

It should be stated that the curve of Spee sometimes means the curved occlusal plane involving lingual as well as buccal cusps of posterior teeth; and much care is sometimes used to grind cusps to articulation in children. This seems unnecessary up to the period of adulthood, unless a dental anomaly is present; because growth, development and function should correct the articulation by producing proper axial inclinations in a well-treated case. After eruption of the third molars or the onset of adulthood, around 18 years, when further growth and development seldom occur, judicial grinding and other means of obtaining desired articulation can be employed; but with adults we should remember that we are dealing with the dentition as a nearly static thing, and that future changes will be due mainly to function and wear.

CONCLUSION

Overbite is merely an indication of the presence of incorrect curves of Spee, and must be diagnosed from the standpoint of the curve of Spee. After the etiology of the abnormal curve of Spee has been decided, treatment and retention are easy and successful, if the diagnosis is correct, and if the patient is healthy and co-operative.

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Lowry Building.

VERIFICATION OF RESULTS OF ROOT RESECTION BY PHOTOMICROGRAPHS

By OBED H. MOEN, D.D.S., M.S.D., Watertown, Wis.

OUR records show that, during the past fifteen years, we have resected the roots of approximately 250 teeth. The object, in all of these cases, has been to eliminate the infection involving the apex and to leave the root end in a condition favorable to repair.

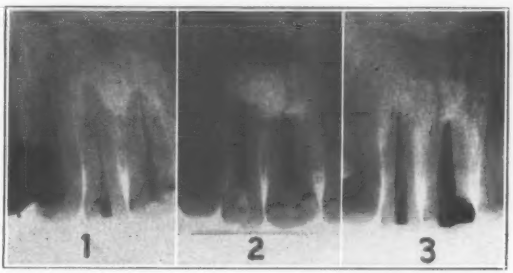

Fig. 1 (Nos. 243, 244).—Roentgenographic record of resected upper central and lateral incisors. 1, condition prior to root canal treatment. 2, condition immediately following root filling and root resection. 3, condition prior to extraction, ten years after root resection.

A majority of these root resection cases were roentgenographed every six months for two years following resection and at less frequent intervals thereafter. It was interesting to note the rapidity with which new bone was laid down in the involved area. A six-month period in some teen-age patients was almost sufficient for complete replacement of the lost bony structure.

Then it was interesting to note in the roentgenograms what appeared to be the development of a peridental membrane. The line representing this membrane usually became of normal thickness and was not broken in any region.

However, in observing these roentgenograms, there was always a question as to the exact tissue condition existing over the surface of the resected root end and the comparable results developing in various types of patients.

Several reports have been made of root resection cases. It is the object of this paper to present the conditions in each case, including the physical condition, and to compare the final results as shown in photomicrographs of the re-

Read before the Section on Histology, Physiology, Pathology, Bacteriology and Chemistry (Research) at the Eighty-First Annual Session of the American Dental Association, Milwaukee, Wis., July 20, 1939.

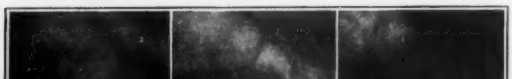

Fig. 2 (No. 246).—Roentgenographic record of resected upper cuspid. 1, condition after root filling. 2, condition immediately after root resection. 3, condition prior to extraction, five years after root resection.

Fig. 3 (Nos. 243, 244, 246).—Roentgenogram of resected upper central and lateral incisors and cuspid prior to extraction; central and lateral incisors in place ten years and cuspid five years after resection.

remove any bone at the apex of the tooth. The cases were all those of regular office patients, and no effort was made to obtain more tissue than would normally come with an extracted tooth. After the microscopic sections were made, there was evidence, in most cases, of much more cementum on one-half of the resected root end than there was on the other half. This leads to the opinion that the leverage used in removing the tooth must have been responsible for separating the membrane and cementum from the root end on one side, while allowing it to adhere on the other side.

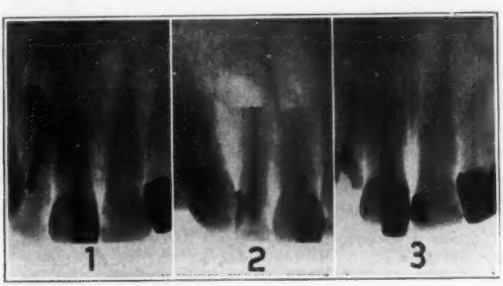

Fig. 4 (No. 245).—Roentgenographic record of resected upper lateral incisor. 1, condition prior to root canal treatment. 2, condition immediately following root filling and root resection. 3, condition prior to extraction, five years after root resection.

sected teeth after they have been retained in the mouth for a varying number of years following the operation.

The teeth that were used in this study were all extracted in the ordinary manner, and it was impossible to attempt to

The six teeth used in this study were all removed for reasons other than those involving the resected root. Extensive caries or conditions necessitating denture wearing are the only reasons we have had

for the extraction of teeth on which root resection has been performed. After the extraction, each tooth was placed in a 10 per cent formaldehyde solution, until six were accumulated. They were then decalcified and sectioned in the pathology laboratory of Northwestern University Dental School under the supervision of E. H. Hatton. The many sections were studied in the pathology laboratory, and the conclusions, in each case, were based on careful study of all sections of each tooth.

regeneration was marked and the tissue of the membrane over the cementum was normal.

In Case 4 (No. 245), the patient, a farmer, aged 65, was rather a rugged type. Although he was older than most patients in whom root resection is performed, a large amount of cementum regeneration was evident.

Case 5 (No. 143), that of a young man, aged 24, who had been asthmatic since he was a child and whose physical condition was below par, showed considerable ce-

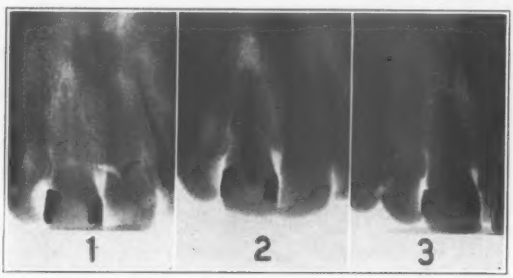

Fig. 5 (No. 143).—Roentgenographic record of resected upper central incisor. 1, condition prior to root canal treatment. 2, condition immediately following root filling and root resection. 3, condition prior to extraction, four and one-half years after resection.

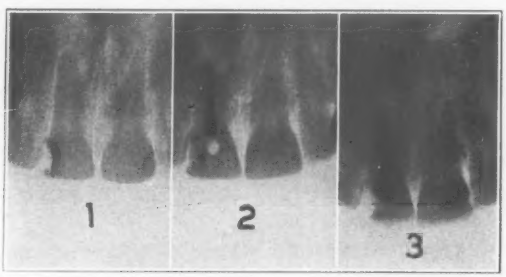

Fig. 6 (No. 142).—Roentgenographic record of resected upper central incisor. 1, condition prior to root canal treatment. 2, condition immediately following root filling and root resection. 3, condition prior to extraction, eight years after resection.

Because of the variation in age and physical condition of the patients, the cases are interesting from a comparative standpoint. The three teeth, No. 243, No. 244, and No. 246, were from the same patient (Cases 1-3), who was in the prime of life and was an especially robust type. In these three cases, the cementum

mentum regeneration nevertheless. The patient's age apparently accounted for this ability to regenerate tissue although the physical condition was below par. There was no evidence of infection in the tissues.

Case 6 (No. 142), that of a frail woman, aged 24, with physical resistance

considerably below par, showed only the slightest beginning of cementum regeneration, although the peridental fibers covering the resected root-end were very evident and seemed nearly normal. It would therefore seem that the general physical condition in this case did not permit cementum regeneration, even though her age was favorable for such regeneration.

It is also interesting to note that in no case was there found any round-cell infiltration permeating the peridental membrane. In the case of the woman whose physical condition was below par, there was evidence of round-cell infiltration where the peridental membrane came in contact with the root-canal filling. Because of the method used in sterilizing the canal before filling, this may be due to chemical irritation, since the round-cell infiltration did not involve the membrane any further than at that point. It

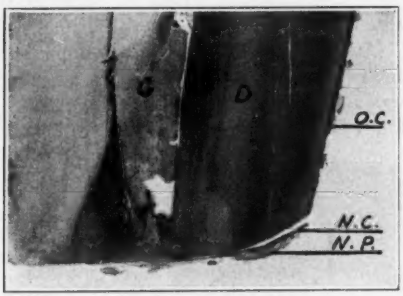

Fig. 7 (No. 243-9).—Longitudinal section of resected root of central incisor, showing new cementum (N.C.) and new peridental membrane (N.P.) formed over resected surface of root. The tooth was in place for ten years after resection. G, gutta-percha root filling. D, dentin. OC, old cementum. (Letters indicate similar areas in all photomicrographs.)

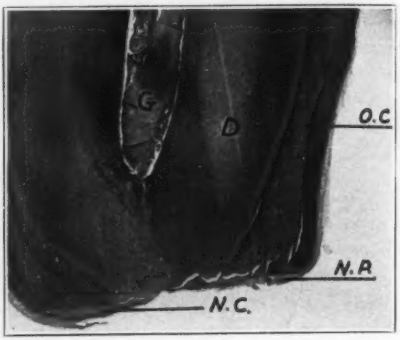

Fig. 9 (No. 244-4).—Longitudinal section of resected root of lateral incisor showing new cementum (N.C.) and new peridental membrane (N.P.) covering resected surface of root. The tooth was in place for ten years after resection.

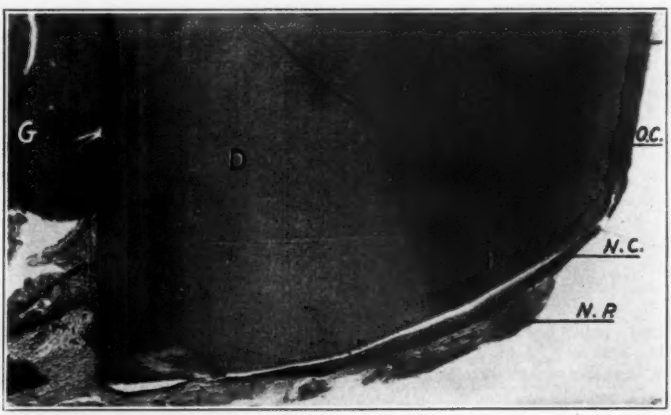

Fig. 8 (No. 243-1).—Higher magnification of another section of No. 243, showing new cementum (N.C.) and new peridental membrane (N.P.) covering resected surface of root; also tissue invagination of canal in contact with gutta-percha root filling (G).

may also be a low-grade infection. In no case did we find the cementum building over the canal foramen. It seemed to build up to the foramen, but did not bridge it.

This paper is presented wholly with the idea of showing the condition actually found and comparing the results according to the age and the general physical condition of the patient.

Fig. 10 (No. 244-2).—Higher magnification of another section of No. 244, showing new cementum (N.C.) and new peridental membrane (N.P.) covering resected surface of root.

REPORT OF CASES

CASE 1 (No. 243).—A man, aged 40, very robust and in good physical condition, with what would be considered normal resistance, had the central and the lateral incisor both involved, with tissue destruction over the apices of both roots. The teeth were retained for ten years after resection and were extracted when all teeth of the upper arch were removed.

The roentgenograms of the upper central incisor show complete rebuilding of bone and what appears to be a normal peridental membrane. (Figs. 1 and 3.)

The photomicrographs show almost complete regeneration of cementum over the entire surface of the resected root-end, except for the canal foramen, with the peridental tissue showing no signs of round-cell infiltration. At the canal foramen, the connective tissue inside the canal is in direct contact with the root filling, forming a complete soft tissue bridge across the foramen. There is almost no evidence of osteoclastic action prior to the laying down of new cementum. The tissue remaining in a lateral canal is nearly normal. (Figs. 7 and 8.)

CASE 2 (No. 244).—The upper lateral incisor was resected at the same time as the central and remained in the mouth for ten years after root resection. (Figs. 1 and 3.)

This tooth also shows in the photomicrographs a layer of cementum covering the root-end even more completely than in the

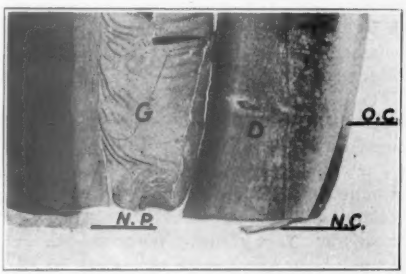

Fig. 11 (No. 246-16).—Longitudinal section of resected root of cuspid, showing new cementum (N.C.) and new peridental membrane (N.P.) formed over resected surface of root; new cementum torn away in extraction as shown by broken edge of new cementum (N.C.). The tooth was in place for five years after resection.

case of the central incisor. There is no evidence of round-cell infiltration in the tissues of the peridental membrane, and the tooth seems to have reached the stage where nor-

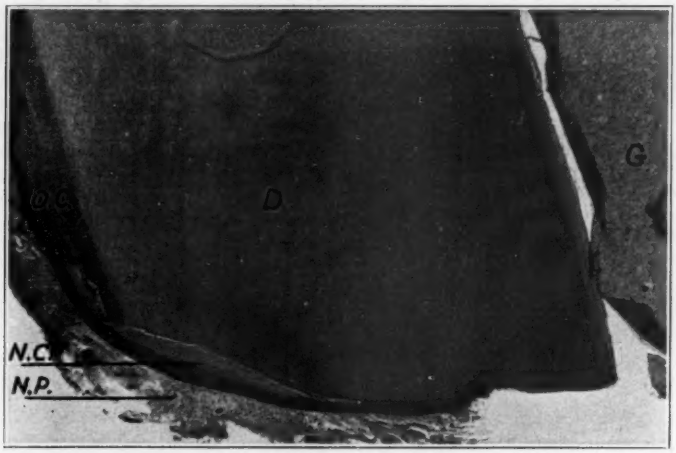

Fig. 12 (No. 246-11).—Higher magnification of another section of No. 246, showing new cementum (N.C.) and new peridental membrane (N.P.) over resected root end.

mal regeneration of cementum would continue. This is virtually the result hoped for in all root resection cases. (Figs. 9 and 10.)

CASE 3 (No. 246.)—In an upper cuspid tooth from the same patient as No. 243 and No. 244, the cuspid root was resected five years after the resection of the central and lateral roots. The patient was 45 years of age at the time of the operation. The tooth remained in position for five years after root resection.

The roentgenograms show normal healing, as in the central and the lateral incisors. (Figs. 2-3.)

The photomicrographs show cementum formation nearly covering the surface of the root-end, with the normal tissue of the peridental membrane showing no round-cell infiltration. The tissue was torn away in extraction over the area in contact with the gutta-percha root filling. The enlarged photomicrograph shows the blood vessels and tissue fibers of the peridental membrane to be nearly normal. (Figs. 11 and 12.)

The three root resections just described were all made in the same case. The age and general physical condition of the patient were favorable for the best results, which show the repair that may be anticipated when this operation is performed for patients with good physical resistance.

CASE 4 (No. 245).—A man, aged 65 and in good physical condition, had an upper lateral incisor which was in place for six years after root resection. It was extracted because the crown broke off and the patient did not wish to have it replaced. The patient's age might seem to contraindicate root

Fig. 13 (No. 245-2).—Longitudinal section of resected root of lateral incisor, showing new cementum (N.C.) formed at margin of resected root surface with uncalcified cementum (U.C.) covering remainder of surface; also tissue invagination of canal around gutta-percha root filling (G). The tooth was in place for six years after resection.

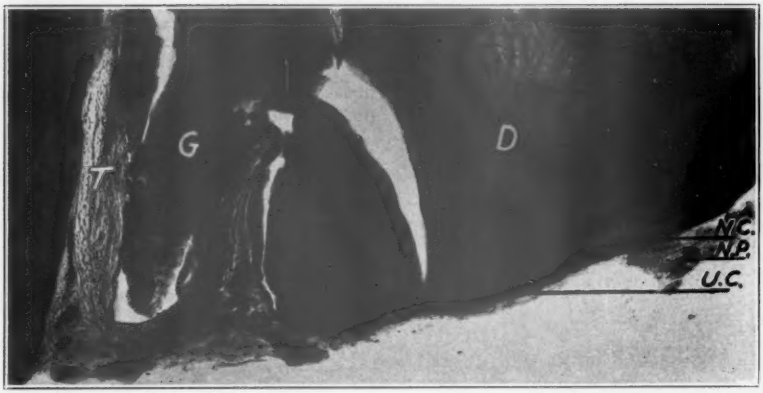

Fig. 14 (No. 245-10).—Higher magnification of another section of No. 245, showing new cementum (N.C.) at margin of resected root surface; uncalcified cementum (U.C.) covering remainder of root surface; tissue invagination (T) of canal around gutta-percha point (G).

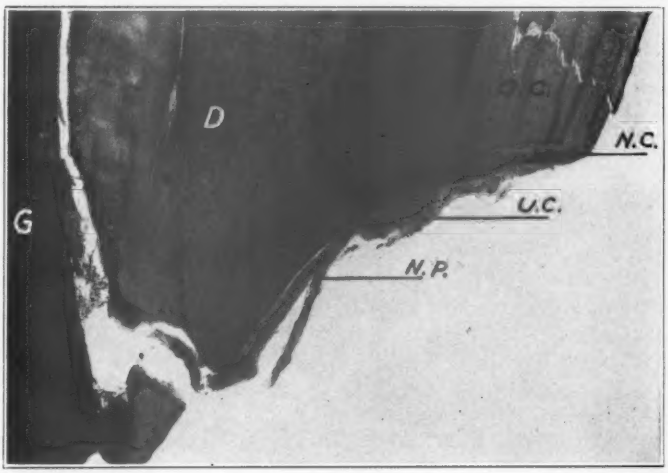

Fig. 15. (No. 143-10).—Longitudinal section of resected root of central incisor showing some new cementum (N.C.) at margin of resected root surface and uncalcified cementum (U.C.) extending halfway to canal. A small amount of new peridental membrane (N.P.) is also intact, covering the remainder of the surface to the canal. The tooth was in place for four and one-half years after resection.

resection. The x-ray film, however, showed what was apparently normal regeneration of bone, and it appeared that the membrane could be traced definitely around the root end. (Fig. 4.)

Photomicrographs of the resected tooth showed considerable new cementum over the margins of the resected root end. The new cementum had not reached the central portion of the root, but had developed from the periphery, covering about one-third of the distance toward the canal. There was evidence of uncalcified cementum over the whole root end. Most of the peridental membrane was torn away in extraction, but what was present showed no pathosis. (Figs. 13 and 14.)

Figure 13 is a section at the center of the

root showing the tissue invagination around the gutta-percha root filling. The secondary dentin in the canal was undoubtedly formed before the pulp was removed. New cementum is especially noticeable at the margin of the root. There is no round-cell infiltration of the peridental membrane. Uncalcified cementum covers the entire surface of the resected root end.

Figure 14 is an enlargement showing new cementum at the margins, uncalcified new cementum over the balance of the resected surface and fibrous tissue invagination around the gutta-percha canal fillings.

In consideration of the patient's age and the short time (six years) during which repair was taking place, this case demonstrates

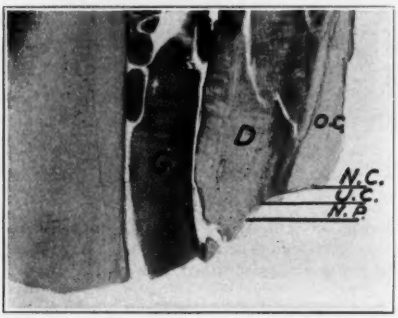

Fig. 16 (No. 143-10).—Enlargement of No. 143-10, showing half of resected root surface with new cementum (N.C.), uncalcified cementum (U.C.) and new peridental membrane (N.P.) covering resected root surface up to canal.

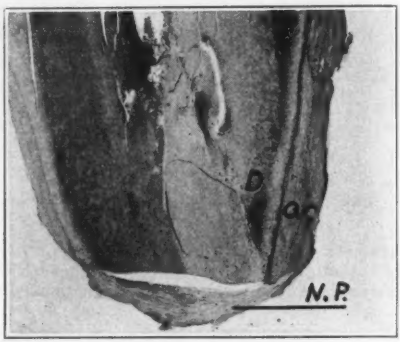

Fig. 17 (No. 142-21).—Longitudinal section of resected root of central incisor which was in place for eight years after resection. There is no evidence of new cementum formation. The resected root surface is covered by heavy new peridental membrane (N.P.).

Fig. 18 (No. 142-1).—Higher magnification of another section of No. 142, showing new peridental membrane (N.P.) covering very thin layer of what appears to be uncalcified cementum (U.C.) over resected root surface. There is round-cell infiltration (R.I.) where the tissue covered the canal foramen.

what can be expected in older patients who are in good physical condition.

CASE 5 (No. 143).—A man, aged 24, in whom the root of the upper central incisor was resected, had been asthmatic since childhood. His resistance was below par, and extensive dental caries was present. The tooth, which was in place for four and a half years after resection, was removed in a full-mouth extraction. The case was considered doubtful from the standpoint of the advisability of root resection.

The x-ray film, however, showed a normal bony regeneration and the development of what appeared to be a normal peridental membrane. (Fig. 5.)

The photomicrographs (Figs. 15 and 16) show formation of considerable new cementum extending over the margins and approximately one-third of the distance toward the canal, and uncalcified cementum extending halfway to the canal. The remainder of the resected surface was covered by a nearly normal peridental membrane. There was slight evidence of osteoclastic action prior to the laying down of new cementum. There was no evidence of infection in the peridental membrane.

Although the patient's asthmatic condition kept him below par physically, his age was apparently a factor in the normal development of new cementum and peridental membrane. (Figs. 15 and 16.)

CASE 6 (No. 142).—A woman, aged 24, of slight build and with a general physical condition below par had had an upper central incisor root resected. The tooth remained in place for eight years after resection and was extracted in a full-mouth extraction. The root canal had been filled after two treatments with a mixture of formocresol and zinc oxide.

The patient was a doubtful risk for root resection. The x-ray film, however, showed what appeared to be normal regeneration of tissue in the apical area. (Fig. 6.)

The photomicrographs (Figs. 17 and 18) show no new cementum forming over the resected root-end, but do show complete fibrous tissue regeneration. There is what appears to be a thin layer of uncalcified cementum adhering to the root-end, beneath which is evidence of resorption due to osteoclastic action. The main fibers of the peridental membrane show no round-cell infiltration, but that portion of the tissue in contact with the root filling shows some. Because of the type of root-canal treatment used in this case, this may be due to chemical irritation. Some of the formocresol saturated zinc oxide may not have been completely removed prior to the root filling.

This case demonstrates the inadvisability of root resection for any person who is evidently below par physically. Permanent healing results should have been evident in a normal case eight years *in situ* after the resection. (Figs. 17 and 18.)

Root resection seems to be indicated when the patient is in good physical condition and when the condition of the teeth and their supporting structures is such as not to interfere with the healing process following the operation. Under these conditions, root resection seems to have very successful results.

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CONTRAINDICATIONS FOR PULP TREATMENT IN DECIDUOUS TEETH*

By Samuel D. Harris, D.D.S., Detroit, Mich.

THE public is coming to understand what good dental care means to them. The importance of dentistry is being realized because the health of the rest of the body is greatly affected by the condition of the mouth and teeth, and dentistry is no longer regarded as a handicraft, but has become one of the leading professions of the age.

In the words of William Osler, "The most important single thing in preventive medicine today is oral hygiene and the preservation of the teeth."

The man who contends that all pulpless teeth should be extracted and he who says that none should be are merely on opposite ends of the same plank. The balance point lies about midway between them. Either extreme position is unreasonable, illogical and, I believe, untenable.[1]

The memorable words of Hunter constitute a battle cry which has rallied in considerable numbers the members of the dental and of the medical profession against the contention that the pulpless tooth is a menace to the health and even to the life of the patient. The words of Osler quoted above are of equal significance, and if quoted with Hunter's words, would tend to stabilize and rationalize our thinking and action.

A decision as to the advisability of treating an infected pulpless tooth must be based on a judicious analysis of the individual case, for each case presents its own problem.

We know that even though infected pulpless teeth have been carefully treated and filled, no present-day method can determine that they are no menace to health. However, in clinical observation, associated with bacteriologic and histopathologic examination of extracted teeth in cross-section, if the roentgenogram reveals no apparent periapical pathosis there is convincing evidence that the response to treatment will be favorable in carefully selected cases.[2]

Every recognized school of dental thought holds that pulp-infected teeth, deciduous or permanent, are fraught with danger to the patient. Extraction is advocated by those who believe that the success of treatment is questionable, speculative or definitely impossible. Treatment is urged by those who feel reasonably certain that many pulp-infected teeth can be restored to health and usefulness.

Those favoring extraction of all infected deciduous teeth present these arguments:

1. There is great difficulty in obtaining and maintaining an unbroken chain of asepsis during treatment. In handling the child patient, management is an important consideration. The very young child, the obstreperous or retarded child and the ill child cannot always be influenced or induced to give the full measure of cooperation required to perform root-canal operations aseptically.

*The papers of Drs. Harris, Wagner, Kohn, Callaway, Dwyer, Waas and Easlick were read as a symposium on pulp management of deciduous teeth.

Read before the Section on Children's Dentistry and Oral Hygiene at the Eighty-First Annual Session of the American Dental Association, Milwaukee, Wis., July 19, 1939.

Further, the use of the rubber dam for the young child is not always convenient or advisable; and without it, surgical asepsis is difficult and usually impossible.

2. There is a lack of specially designed equipment for the treatment of deciduous teeth with their smaller root canals. In this service, we temporize with equipment at every turn. We might need to use a bicuspid clamp to hold the rubber dam in place on a deciduous molar or a deciduous upper incisor; to use permanent tooth reamers and files to clean out and enlarge the root canals of the deciduous tooth, and to employ permanent tooth root-canal filling material altered and adapted for filling the pulp chamber and root canals of the deciduous tooth.

3. To date, no one has advocated a technic for successfully cleaning and filling the deciduous root canals to their end. Actually, we avoid the root end when using files or reamers in deciduous root canals. We have learned that if we accidentally permit an instrument to pass through the end of the root canal and jab the sensitive tissues beyond, an acute flare-up of the tooth condition generally follows and extraction for relief often becomes necessary.

4. As a result of resorption of the deciduous tooth roots, the canals are at times wide open and funnel shaped. For this reason, those of us who advocate the treatment of infected deciduous teeth usually do not enter the root canals; and when we do, we clean and fill them only in part. The untreated, unfilled portion at the end of the canal may be a potential site for a hidden low-grade infection.

5. The hazard of failure in treatment must be considered, and unfortunately the failures are not always evident or detectable. The x-ray machine has been a great boon to diagnosis, but we do know that negative roentgenographic evidence does not always signify an absence of infection.

6. There is a potential danger from treatment failure to sensitive and growing tissues and organs. Just how much damage a low-grade infection can do to a child's system it is difficult to say. We have had cases wherein adverse systemic conditions cleared up when treated deciduous teeth were extracted.

7. The advocate of treatment is unable to say with positiveness and to present scientific evidence that the treated, clinically healthy, non-vital deciduous tooth is 100 per cent safe and that it cannot impair the child's growth or his development. We can say that the treated tooth is negative clinically and roentgenographically, in our opinion, to substantiate which a bacteriologic checkup would be useful, but this is not always available, practicable or possible.

8. A simple and effective space maintainer can usually be prepared and placed in the time taken for proper root-canal treatment. A simple maintainer can be prepared by fitting a band to the adjoining tooth, or teeth, and then attaching to this a tissue-bearing 30-gage wire, contoured to the gingiva of the extracted tooth. This should take altogether only about forty-five minutes to an hour. (It should be noted that a space maintainer is not always necessary when a deciduous tooth has been lost prematurely.)

Much has been written pro and con on the subject of 100 per cent extraction of infected teeth. Some time ago, Rosenow contributed an article[3] in which he advocated the removal of all pulp-involved teeth, citing a number of men in agreement with his views. Briefly, the contention of Rosenow and those who share his opinion is that streptococci can be more readily isolated from pulpless teeth than from normal teeth, and that pulpless teeth are therefore a menace to health and should be extracted.

The fact that such an authority on the eye as William H. Wilmer would state that the man who undertakes an intraocular operation without eliminating dental areas of infection first "assumes a grave risk for the success of the opera-

tion," indicates its importance in operative eye cases.

W. C. Miller, of the Manhattan Hospital, supports Doctor Wilmer,[4] stating that, in his own case and practice, he would not willingly tolerate any pulpless tooth. Dr. Miller adds that this may be considered a radical statement and quite at variance with the generally accepted precepts of the medical profession, but, with the opportunities available to him for observing possibly thousands of roentgenograms of patients suffering with specific eye conditions and general systemic infections, he believes that the results of the operation do not warrant the risks attendant on it.

Since an infected root canal can harbor bacteria capable of causing serious local or general injury, and the protection of the patient is of paramount importance, and since measures designed to provide this protection cannot be too exacting, many pulp infected deciduous teeth should be extracted.

Teeth deemed definitely unfavorable for treatment are:

1. Those that have a periapical abscess.

2. Those the roots of which are two-thirds or more resorbed.

3. Those that have been penetrated at the root bifurcation by infection or caries.

4. Those that have insufficient crown structure left to permit an adequate restoration.

5. Those in an unhealthy mouth. The general health of the child may demand extraction of the teeth in question.

As regards extracting infected deciduous teeth when there is a possibility of systemic involvement, we would do well to support the views of Clifford D. Sweet. He says:

> I use my authority, as the medical adviser of the child, in demanding the extraction of deciduous teeth no matter what the judgment of the dentist may be, if the child has a serious constitutional disorder, such as nephritis, nephrosis, recurrent acute rheumatic heart disease—which makes it necessary to say that we must sacrifice the welfare of the mouth for the sake of the child's welfare.

In addition to the above widely observed conditions, there are other times and other conditions in which treatment of an infected tooth is not justified in the opinion of the examining dentist. However, when no such contraindication exists, treatment of an infected deciduous tooth can be undertaken with every assurance that, in perhaps as many as nine out of ten cases, the result will be clinically satisfactory.

In reviewing the dentist's attitude toward treatment of pulp-infected deciduous teeth, it would seem that more dentists are treating these teeth than ever before, but that those who do treat them are considerably more selective regarding the teeth to be treated.

The following excerpts and opinions are an indication of the stand of pedodontists in this matter today. Charles A. Sweet writes: "The devital deciduous tooth reacts properly when it is treated." Walter C. McBride: "I seem to be getting the same good results as previously and am using the same medication." Floyd E. Hogeboom: "I am treating them when indicated." John C. Brauer: "Having eliminated all contraindications, treatment is undertaken in well-selected cases." J. M. Wisan: "I treat carefully selected pulp-infected deciduous teeth." Frank F. Lamons: "I have advocated treatment where conditions are favorable, but I am inclined to treat fewer." Ralph L. Ireland: "Treatment is readily undertaken for infected deciduous teeth which are considered favorable for treatment." Kenneth A. Easlick: "Root-canal therapy is readily undertaken in selected cases."

CONCLUSION

Much of the censure heaped at the door of the treated non-vital tooth is

undeserved. The trend today is definitely toward a demand for more scientific evidence, if we are to be swayed from our belief that well-treated, clinically sound, roentgenographically negative teeth are a benefit to our patient.

In the meantime, the technic for treatment of the deciduous tooth is receiving careful attention both from dentists in private practice and from dental colleges. Careful records and frequent roentgenographic checkups, along with bacteriologic investigations wherever and whenever these are available, will help further to bring out the facts in this important question.

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PULP TREATMENT OF DECIDUOUS TEETH

By RALPH O. WAGNER, D.D.S., Oakland, Calif.

IN a recent poll of controversial subjects in children's dentistry, pulp treatment of deciduous teeth received the most votes. This is not surprising when we consider the handicap that we place upon the child and the increased financial burden that we place upon the parents by the premature extraction of deciduous teeth. More and more, we are realizing the importance of a complete deciduous denture.

By the retention of properly treated, exposed or infected teeth, we eliminate the cost of space retainers, and the even greater expense of orthodontic treatment necessitated by the early loss of these teeth.

By retaining deciduous teeth, we eliminate one of the reasons that we have "dental cripples." We prevent children from growing into adult life with disfigured faces. We eliminate much mental suffering, the inferiority complex and loss of employment because of the appearance. The space lost when teeth are missing results in crowding and irregularity of the permanent teeth, which invite more extensive dental disease, both of the teeth and of the investing tissues.

In the average practice, there are many patients who can ill-afford the treatment necessitated by loss of deciduous teeth. Therefore, the conscientious operator must hesitate before he extracts a single deciduous tooth. In my opinion, many teeth are extracted because of lack of knowledge of deciduous root therapy.

The first step in pulp treatment of deciduous teeth is to educate the parents of the patient to the realization that the need for pulp treatment may be eliminated when prophylaxis and operative procedures are instituted at an early age. By stressing the dangers of neglecting children's teeth until pulp treatment becomes necessary, we frequently eliminate this complication. Whenever possible,

Read before the Section on Children's Dentistry and Oral Hygiene at the Eighty-First Annual Session of the American Dental Association, Milwaukee, Wis., July 19, 1939.

before lay audiences or medical or dental groups, the importance of early and regular dental care should be stressed. Thus, our first step in pulp treatment is, through education, to gradually eliminate the need for this branch of children's dentistry. While we do not think that root treatment is the ideal for children, it offers us the best alternative until children are brought to us for care at such an early age that pulp treatment may never become necessary.

TREATMENT OF EXPOSED TEETH

Since it has been my experience that pulp capping is not successful in deciduous teeth, I remove the pulps in all cases of exposure. The experience of others has been similar. I quote H. R. Foster:

> . . . Not one of the eighteen references consulted suggests pulp capping, even though the tooth is uninfected, and eleven of the eighteen deliberately advise against it, reporting only failure where it has been attempted. Hogeboom reports that this is because the deciduous pulp has to resorb the roots of the deciduous dentition, and that it is this resorption process which militates against a successful pulp capping in a deciduous tooth.[1]

At the first visit, anesthesia, either block or local, is employed, as indicated. The tooth is then isolated, the bulbous portion of the pulp is removed and a pellet of cotton containing eugenol is sealed in for two or three days. As an alternative, if the administration of a local anesthetic is difficult, a capping disk is used. From one-quarter to one-half wafer is dipped in phenol and sealed in the tooth for one or two days to devitalize the pulp.

At the next visit, the tooth is isolated, the first eugenol application is removed and the root canals are gently cleaned out by means of a broach. It is advisable to remove only the coronal portion of the root canal, and if a curved explorer is used, one is not apt to penetrate too deeply. It is important to bear in mind that the developing tooth has a foreshortened root canal. The canal is often only one-third to one-half the length of the root owing to resorption. An application of formocresol is sealed in the canal and left there for two or three days.

If the arsenic wafer was sealed in at the first treatment, it is removed, the bulbous portion of the pulp is cleaned out and formo-cresol is sealed in and left there for two or three days.

At the third visit, if an anesthetic was used on the first visit, the tooth is filled. A creamy mix of zinc oxide and eugenol is prepared, the tooth is isolated and the previous medicament is removed. The pulp chamber is dried and the mixture of zinc oxide and eugenol is introduced into the root canal with an explorer. A larger portion is placed in the pulp chamber and, with a large pellet of cotton, this is pumped into the canals. The paste is then covered with zinc oxyphosphate cement and a permanent amalgam filling is inserted.

If arsenic trioxide is used to devitalize the pulp, the previous medicament is removed, the canals are gently cleaned out with a broach and another application of formocresol is sealed in. The fourth treatment is necessary in these cases to fill the canal and tooth as previously described.

TREATMENT OF INFECTED ROOT CANALS

I do not attempt to treat all infected root canals. In the following conditions, the teeth must be extracted:

1. Dental infection in children whose health is very poor, extraction to follow consultation with the pediatrician.
2. Caries penetrating the bifurcation of the roots.
3. Resorption of two-thirds of the root or roots, either normal or due to infection.
4. A fistulous opening at or around the gingival margin of the tooth.
5. Absence of the permanent tooth normally following the deciduous one.

Contraindications will be further dis-

cussed during the symposium, but the above-described teeth must be eliminated from the infected teeth in which root-canal treatment can be attempted. In treating exposed or infected teeth, certain precautions must be observed to prevent reinfecting the tooth:

1. The tooth should be cleaned of any débris in the cavity or the adjacent teeth.

2. Gauze or cotton rolls should be packed on the buccal and lingual sides of the tooth.

3. All instruments to be used in the tooth should be sterilized in a 60 per cent solution of alcohol.

4. The tooth and surrounding area should be wiped with alcohol and dried with hot air after the tooth has been isolated with cotton or gauze.

5. A saliva ejector should be used.

6. All necessary instruments and medicaments should be in readiness. With a well-trained assistant, medicaments can be changed rapidly, to eliminate the possibility of reinfection.

First treatment: All material in the pulp chamber is cleaned out with a bur or spoons and the pulp chamber is washed with an antiseptic solution. Formocresol is sealed in for two or three days.

Second treatment: The formocresol is removed and all tissue is removed from the upper one-third of the roots.

Third treatment: Another application of formocresol is sealed in for two to three days.

Fourth treatment: The tooth and root canal are filled as previously described.

In some cases, the fistula will remain after the tooth is filled because necrotic bone remains in the area of the fistula. The rose bur treatment as described by Charles A. Sweet[2] should be used when the fistula persists. The treatment consists of placing an anesthetic on the fistulous area and, with a large round bur in the contra-angle handpiece, inserting the bur through the fistulous opening and removing all the soft necrotic bone.

SUMMARY

1. Root treatment should be practiced whenever the prognosis is favorable in order that a full complement of deciduous teeth may be retained until time for normal exfoliation, assuring for the child normal facial development and the correct placement of the permanent teeth.

2. Whenever an oportunity presents itself, the public should be acquainted with the need of early and regular dental attention in order that no deciduous tooth shall be prematurely lost.

3. A sterile field must be maintained and speed should be developed without the use of the rubber dam, so that applications used in treatment may be changed before the saliva of the mouth has an opportunity to reinfect the tooth.

4. Only the upper portion of the pulp tissue is removed and care is exercised that the broach be not inserted beyond the apical opening. Owing to the resorption process, an incompletely filled root soon becomes completely filled.

5. It is important that teeth be treated only when the prognosis is favorable.

6. When a fistula remains after the root-canal work has been completed, Dr. Sweet's rose bur technic should be employed.

7. A permanent restoration must be made after the roots are filled in order that normal contact shall be restored and gingival irritation be eliminated.

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SPACE RETENTION WITH FIXED COMPENSATING BRIDGES

By Leonard Kohn, D.D.S., Brooklyn, N. Y.

IT does not seem possible that in this day and age the case for space maintenance needs justification in the eyes of the dental profession. It is generally admitted that, in many cases, the cause of malocclusion is premature loss of the deciduous teeth. It is also generally agreed that premature loss of permanent teeth is the cause of subsequent loss of other permanent teeth, misplacement, undue stress, drift and periodontal conditions.

This paper will be limited to a résumé of the topic in its application to young children and adolescents.

This presentation is predicated on the mechanics of the development of the facial portion of the skull and of the maxillae and mandible in particular. Brash says "The growth of the alveolar arch—of the jaws is only part of a much larger subject."[1] Keith says "We can never understand the conditions which give rise to the displacement of teeth until we know how growth of these parts takes place under all conditions both normal and abnormal."[2] From many other investigators, beginning with Hunter in 1772 and coming down to T. Wingate Todd and Broadbent in our own time, we have learned that the facial portion of the skull develops essentially in three directions: forward, downward and outward, by surface addition and resorption of bone and a thrust forward *en masse* by posterior addition to the bones. This is termed directional development.

In addition, in both the maxillae and the mandible, there is growth of bone tissue in certain areas for tooth accommodation. When this occurs in an area in which a tooth is about to erupt, it is called sectional development.[3]

Recognition of these growth areas and directions of growth has made it necessary for us to change our ideas and to seek appliances which will meet the conditions arising from the growth and development of the face. Let us remember, as exemplifying this growth, that the six upper and the six lower anterior teeth are broader mesiodistally than the deciduous teeth and that the upper and lower first bicuspid teeth are narrower mesiodistally than the first and second deciduous molars. This condition is evidenced by the spaces created between the anterior teeth in a developing mouth.

It is incumbent on us to consider all of these facts before we design an appliance to maintain space. Each case should be decided on its own merit and should have its own individual design. We are obligated to plan and construct appliances that will prevent loss of the original space and will still expand with and move in the direction of normal facial development and growth.

If there were no need for space maintainers, as has been contended by Lewis, Hellman and others, there should be no orthodontic cases arising from a forward drift of posterior segments of the teeth or the collapse of anterior segments, per-

Read before the Section on Children's Dentistry and Oral Hygiene at the Eighty-First Annual Session of the American Dental Association, Milwaukee, Wis., July 19, 1939.

mitting the crowding out of the anterior permanent teeth. In my experience, there are too many cases of this type and I am somewhat at a loss to classify them.

One typical case of anterior collapse is shown in Figure 3 and one of posterior collapse in Figure 4. Cases of similar type are avoidable. In my practice, when a device has been properly planned and so constructed that it will move with and in the direction of normal development and growth, there has always been room mesiodistally for the erupting permanent tooth.

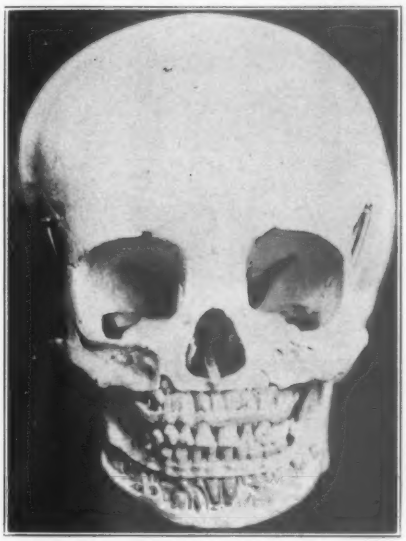

Figure 1.

It is not the contention that the mouth in which a space maintainer has not been placed will not develop properly: the chances of development are better. Because the use of an improperly planned appliance may inhibit the growth of the various segments, a note of caution is sounded regarding such appliances, which may act contrary to their purpose, hindering the sectional development of the mandible and the maxillae.

These considerations have led to the establishment of three cardinal principles in appliance design[3]:

1. Any appliance in the anterior part of the mouth which includes the canines must compensate for lateral growth and development of the bones of the face.

2. Any appliance in the posterior part of the mouth which includes the canines must compensate for lateral growth and development of the bones of the face.

3. Any appliance in the posterior part of the mouth which does not include the canines may be fixed.

These rules have led to the creation of a set of new appliances for the mouth of the developing child. Since 1930, my contributions to dentistry have been the development and the teaching of the use of such devices. These appliances are called fixed compensating bridge space maintainers, using cast orthodontic bands as abutments and moving with and in the direction of normal facial development and growth.

The belief has been widely expressed that any appliance that will maintain space is sufficient, and that, with any space maintainer, the permanent tooth will erupt in proper position. This is not a true statement. Teeth may erupt either in malposition or in malrelationship in spite of space maintainers. Various appliances have been discarded in the belief that the entire problem is greater than one of space maintenance alone. In fact, the maintenance of space is only one of ten points in the entire problem. To bear this out, a decalog of requirements for devices which are to intercept malocclusion have been set up. These are as follows[3]:

All appliances (1) must retain the original space; (2) must compensate for and move with and in the direction of normal facial development and growth; (3) must restore function; (4) should allow the abutment teeth to move in function if possible, but not beyond functional movement, to avoid luxation; (5) should restore the appearance to nor-

mal; (6) should aid in phonation; (7) must prevent elongation of the teeth in the opposing jaw; (8) should be easily cleaned; (9) should be constructed so that they can be removed easily for periodic inspection and for alteration when the eruption of a permanent tooth is imminent, and (10) should be constructed without the cutting of any surface of the abutment teeth.

Any appliance or device, to be successful, must meet 80 per cent of the decalog of requirements. The question "What have we done and what shall we substitute for the conventional space maintainer?" arises. The recommendation is made that a more efficient appliance be used; one which will meet at least 80 per cent of the requirements listed above. For this purpose, I have designed and have been using for many years an anterior compensating bridge space maintainer and a posterior compensating bridge space maintainer. The construction of

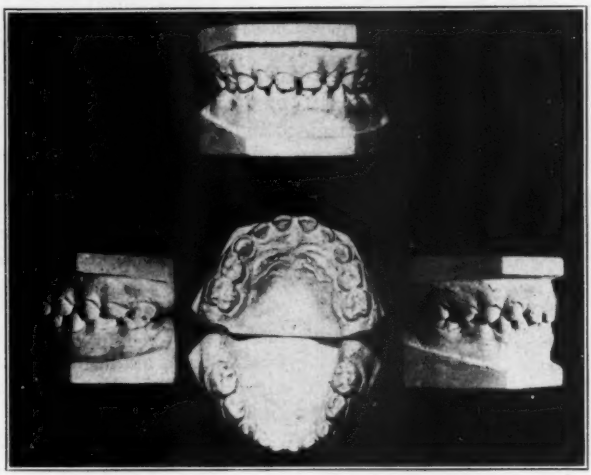

Figure 2.

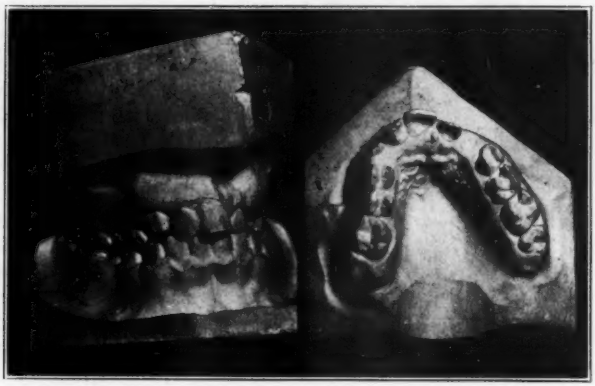

Figure 3.

and reasoning behind both of these devices were outlined before the American Dental Association in a clinic in Buffalo in September 1932, and reiterated in detail in an essay read before the Association in San Francisco in July 1936. For those who have not read these articles, I shall demonstrate an anterior compensating bridge space maintainer with its simple pin and tube device permitting movement of the abutments.[3]

This device meets about 95 per cent of the decalog of requirements.

For the posterior teeth, a compensating bridge space maintainer was designed and constructed to move with and in the direction of normal growth and development. The abutment pieces are cast orthodontic bands and the attachment which permits the movement of the teeth is a ball and socket joint.

A few salient points must be borne in mind. One is that the concept of facial development and growth must be accepted in order to plan a successful space maintainer. Each space maintainer must be designed and constructed to meet a particular need. Consideration must be given at the time of loss as to whether the permanent teeth will erupt in the immediate future. If it is believed that they will not, an appliance for space maintenance should be inserted. The design is dependent on the position and the number of teeth lost and the position of those in the opposing jaw. All appliances must compensate for future facial development and growth when and where there is a need for it. When there is need, the appliance should move with and in the direction of development and growth. The belief, after clinical observation, is that fixed compensating bridge space maintainers are superior to cast or wrought gold appliances because they come closer to meeting the ten requirements as laid down in the decalog of requirements.

Bridges of the type herein described are preferable to space maintainers because they not only maintain space, but also compensate for the growth of the face, maintain function, restore appear-

Figure 4.

Figure 5.

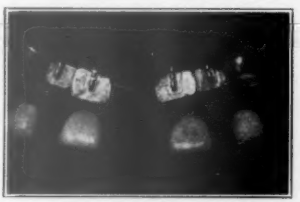

Figure 6.

Figure 7.

ance, aid in phonation, prevent elongation, are easily cleaned, are constructed without cutting of any part of any tooth and are easily removed for inspection or alteration, and the posterior bridge allows the abutment teeth to move in function.

Most cases of malocclusion can be circumvented by the judicious placement of a properly planned compensating bridge space maintainer. However, these too may not always intercept malocclusion.

There are many other points to be borne in mind upon which I can only touch lightly. Good undistorted directional roentgenograms are necessary to

Figure 8.

determine the position of erupting teeth before plans are made to place any device to maintain space.

If the decision is that no appliance is necessary, it is desirable that monthly examinations be instituted. These examinations should consist of more than ocular observations and measurements in the mouth and on models. An accurate and corrected modeling compound bite-block should be made at the first sitting; and if, on future examination, the edges of the block nick, it is evident that the teeth are moving.

Another way of checking is to cast an accurate reproduction of the mesial and distal upper third of the teeth adjacent to the space, allowing each casting to extend onto the occlusal surface. A length of 0.040 wire is soldered between these two castings so that the entire device will go to place accurately on the teeth. Failure of the device to fit on subsequent examination indicates that the teeth are moving.

In conclusion, let me make a plea for deeper study in the application of basic

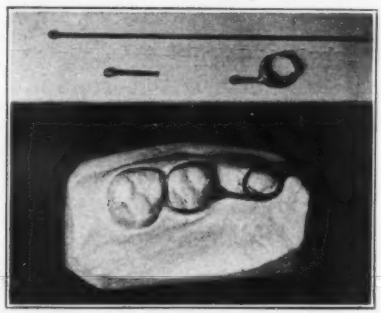

Figure 9.

principles prior to the use of space maintainers, with more careful planning of the appliance and consideration of its use where needed.

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CONTRAINDICATIONS FOR SPACE MAINTAINERS IN THE MOUTHS OF CHILDREN

By George S. Callaway, D.D.S., New York, N. Y.

FOR the purposes of this paper, the age limit of the children under consideration for treatment is set at that time when the permanent dentition is completed, excluding the eruption of the third molars.

I definitely do not wish to be placed in the category of dentists who say that space maintainers are not necessary, as it is my firm belief that many cases of malocclusion and the evils that follow it can be prevented by maintenance of space for the eruption of oncoming teeth.

The only positive contraindication to the use of a space maintainer where there is a break in the continuity of the dental arch is death. While the life processes continue, there are continual changes and adjustments, particularly during periods of rapid growth. Usually, it is thought that when a deciduous, or what has lately been aptly called a foundation, tooth is lost, no matter what the cause, if, after an x-ray picture has been made of the area, it is thought that the succeeding permanent tooth will not erupt within a period of six months, a space maintainer is needed. This is a safe practice, and an error of commission in the placement of a maintainer is far more excusable than an error of omission.

Owing to the fact that permanent incisors are larger than deciduous incisors, the growth urge is still present after premature loss of a deciduous incisor, and clinically we find that space maintenance is not usually necessary. Even in these cases, however, care should be observed, and the rule of Stanton should be remembered: the space between the mesial edges of the two lower deciduous canines should be equal to the sum of the mesiodistal diameters of the lower deciduous canine and first and second deciduous molars on one side, in order to accommodate the oncoming four lower incisors. If a permanent incisor, either maxillary or mandibular, is lost previous to the eruption of the remainder of the permanent teeth, the use of a space maintainer of some description is very important.

In the buccal regions of the dental organs, the periods of growth can be taken into consideration. The periods of dentofacial growth are usually coincident with or just prior to the eruption of the permanent molars. At these times, the result of the growth urge is apt to be lost if there is an open space in the buccal segments of the dental arch. At other periods of time, unless the teeth are crowded owing to lack of bony growth, spaces caused by early loss of the deciduous molars are not so apt to close, but they have to be watched continuously. The space left by the loss of the first deciduous molar is less apt to close than that caused by the loss of the second deciduous molar, and closure is less apt to ensue in the mandible than in the maxillae.

After the loss of any deciduous tooth where there is a possibility of the space closing, it is advisable to give the child, or preferably the parent, some material to be used as a gage that will just fit in the space formed, either a block of dental compound molded to fit or a small block of wood trimmed to size. This

Read before the Section on Children's Dentistry and Oral Hygiene at the Eighty-First Annual Session of the American Dental Association, Milwaukee, Wis., July 19, 1939.

can be tried in place periodically, and as long as it can be placed in position, we know that the space is not closing and so a maintainer is not necessary. However, as soon as it becomes impossible to place the gage in position, it is evident that some steps must be instituted to preserve the necessary space for the eruption of the succeeding tooth.

A factor of great importance in preventing drifting of the teeth is the interlocking of opposing cusps. With sharp, well-defined cusps in good occlusion, there is a tendency for this locking to prevent teeth from drifting.

I have not mentioned the extrusion of the opposing teeth attending loss of tooth structure. This should be given as much consideration as the loss of space and should be anticipated and prevented.

Space maintainers are contraindicated if the follicles of the permanent teeth are absent or missing and it is deemed advisable to close these spaces to obviate a future prosthetic replacement. Even here, each case is an individual problem, calling for special study. In cases of so-called distal occlusion, particularly when there is a lack of mandibular growth, I should advise preservation of the spaces caused by loss of the second deciduous mandibular molars, even though the bicuspid or premolar follicle is absent, until such time as the distal occlusion has been corrected.

In conclusion, I would say that there is no definite contraindication to the placement of space maintainers in the mouths of children.

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DOES EXPERIENCE JUSTIFY PROPHYLACTIC ODONTOTOMY?

By H. SHIRLEY DWYER, D.D.S., Brooklyn, N. Y.

AS my part in this symposium, I shall consider the question "Does Experience Justify Prophylactic Odontotomy?" from four angles: 1. Motivating known conditions. 2. The problem. 3. The scope of the problem. 4. Methods of attack.

1. The motivating known condition. From 90 to 96 per cent of school children in the United States have dental caries, and, as a result, from 70 to 75 per cent of adults (on relief rolls) are in need of dentures, owing to a 60 per cent loss of masticating efficiency.

2. The problem. To eliminate or prevent this condition is the problem.

3. The scope of the problem. Any disease affecting from 90 to 96 per cent of our child population ceases to be an individualistic problem and becomes a community problem, requiring social consideration and a public health viewpoint of treatment.

4. Methods of attack. What proved method or methods which meet the essentials of preventive practice are to be considered as practical? It is fairly well-established practice, with our present knowledge, to recommend three control measures:

a. Mouth hygiene, which, like any other surface cleansing process, is an adjunct to health and esthetics, but not of itself necessarily a specific preventive.

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b. Diet, which means changing the dietary habits of an entire nation. At present, being complicated with emotions and endocrines, it is still in the experimental stage.

c. Operative intervention or prophylactic odontotomy, which, like vaccination, is a known specific, simple of application, painless, quick and inexpensive.

Milton J. Rosenau, authority on preventive medicine and public health, says of vaccination: "Vaccination is a minor surgical operation. No person unfamiliar with surgical cleanliness should be permitted to perform this 'little' operation." Like vaccination, prophylactic odontotomy is a justifiable operation, and, like any other operation, it must be properly performed. One author speaks of his horror at cutting into a beautiful tooth. This is unadulterated emotional buncombe, comparable to refusing to protect a child's future health by vaccination because of possible scarring of the beautiful skin of the arm—a rationalization of the operator's negligence in failing to take all known measures to protect the child's future dental health. The failures in prophylactic odontotomy occur in the hands of the negligent operator and cannot be blamed on the operation. Let us briefly state the essentials of a preventive service to determine whether experience with prophylactic odontotomy fulfils these requirements.

1. Ease of application. Prophylactic odontotomy consists practically of the preparation of a pit or fissure so that a simple Class I cavity is formed, which is then filled. I leave it to the dental profession to demonstrate a simpler operation in the whole field of dentistry. For authority, I refer to "Health Dentistry for the Community," wherein we find:

> Investigations have shown that dental caries is particularly apt to occur on certain surfaces of the teeth because of imperfections in the anatomical structure of those surfaces. These imperfections in structure lend themselves very easily to correction; simple operations, which require little time and effort, prevent the spread of decay in these defects and thus protect the teeth.[1]

2. Painlessness of operation. It is only when the earliest possible application of prophylactic odontotomy has been neglected that pain becomes a factor in most Class I cavities. With a sharp bur and an engine at slow speed, prophylactic odontotomy is a quick and painless operation. J. M. Wisan[2] writes: "The fact that the operation (prophylactic odontotomy) was *painless,* increased the child's willingness to obtain dental treatment."

McBeath, in a recent article on dentistry for children, suggests choosing the smallest defects first because "The simplicity of the operation and minimum of discomfort will not permit realization of the child's fears and he becomes more receptive for more complicated procedures at subsequent visits."[3]

3. Economy of operation. Maurice William writes:

> Since every enamel defect must, for reasons already stated, grow progressively worse unless immediate corrective treatment is provided, it is to the greatest advantage of the patient that the treatment be instituted immediately, which means in early childhood. Such measures (prophylactic odontotomy) are simple, speedy, and therefore inexpensive.

Whether it be in public service or private practice, time is the principal factor in cost, and any operation which conserves time reduces cost. Dr. Wisan again furnishes us with evidence when he says:

> Prophylactic odontotomy proved to be an economical procedure, since it was possible to perform a greater number of operations than if the teeth were allowed to decay before treatment. According to figures compiled by the County Superintendent's office, the cost per operation was $0.69, the lowest cost reported among the seventeen school dental clinics in Union County.

4. Universality of application. No scientific data have as yet been published nor criteria evolved which indicate a predictable immunity to dental caries in children. On the contrary, much material has been published showing the universal

prevalence of enamel defects and their need of immediate correction.

A study made in 1928 by carefully trained observers using specially prepared charts showed the following:

> On a re-examination made nine months after the first one, it was found that out of 616 pre-carious fissures, there were developed 568 carious cavities. Another way of stating this would be that 92.2 per cent of the fissures had become carious cavities in nine months' time.[1]

The report of the Clara Wachtel Dental Clinic in Jerusalem emphasizes this as follows: ". . . prophylactic fillings, for instance, valuable to the child of six or seven years old, are much more so to a child three or four years of age."[2]

5. Practical prevention through prophylactic odontotomy. Is it practical and what may we expect? Let us see what others have to say.

E. E. Starr writes: "Logical thinking decides that prophylactic odontotomy is indicated in all deep pits and fissures in newly erupted first molars."[4]

Isadore Teich states: "As soon as the tooth has sufficiently erupted, these pits and fissures should be filled in the usual way."[5]

Report of the Clara Wachtel Dental Clinic: "The essence of prevention obviously lies in the early detection of defects and their correction."[1]

An observer in New Zealand says: "In New Zealand, where every school child receives the benefits of prophylactic odontotomy, the reduction in the loss of teeth has been most marked."

Dr. Haenke, of Australia, reports lowering costs of dental care with increased saving of teeth as the result of prophylactic odontotomy.

J. M. Wisan, in his report "Preventive Dental Service in the School Clinic,"[2] says: "All the permanent molars that have received prophylactic odontotomy treatment are now in sound condition." He also shows some interesting results through a period of years as the result of this practice; for instance, an increase in the percentage of school population taken care of by the clinic of from 25 per cent in 1930 to 66.6 per cent in 1933, with fewer clinic hours (185 hours in 1930 to 174 in 1933) and a reduction in the number of defective teeth per pupil: seven defects per pupil in 1930; two defects per pupil in 1933.

Similarly, it might be pointed out that, during the seven years in which the New York University Child Research Clinic was in existence, we did not lose one first permanent molar. Prophylactic odontotomy was carefully practiced in this clinic, and we had ample opportunity to observe and record the effect of time on these cases.

Every properly conducted dental service program in this country emphasizes the necessity for caring for pits and fissures—prophylactic odontotomy. Public health departments are dependent on budgets for their funds, and proof of accomplished good must be shown before money is allotted. One of the features of the New York City program is the immediate care of all pits and fissures.

Is there any justification for the practice of prophylactic odontotomy? Just as I have striven throughout this paper to keep my own personal views out, so I now propound the question, with the one request that facts rather than subjective observations be accepted. Remember: "The enamel defect of today is the carious cavity of tomorrow."

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HAS EXPERIENCE JUSTIFIED PROPHYLACTIC ODONTOTOMY?

By Milton J. Waas, D.D.S., Philadelphia, Pa.

PROPHYLACTIC odontotomy is a measure for the prevention of dental caries, first advocated by Thaddeus P. Hyatt, and consisting of filling the pits and fissures of the deciduous and permanent posterior teeth.

The question Is prophylactic odontotomy a success? is an ambiguous one. "Success" may be judged upon varying standards. What I might consider a success, one of my confrères might deem a failure, and from a study of identical statistical data.

In judging whether prophylactic odontotomy is a success, we must analyze the operation on the basis of its two fundamental applications, in public health work and in private practice. From the standpoint of a public health measure, I would say that it is a failure. From the standpoint of private practice, the necessity for it in a carefully conducted practice has been overestimated.

The trend in scientific medical practice is marked by a stress on prevention of illness or infection even more than on cure. This note of prevention is even more accentuated in the field of public health service. For analogy, I shall mention vaccination for smallpox, an acknowledged success as a public health measure. The reasons are several: It is easy to apply; it can be applied quickly; application is almost painless; the cost is negligible; expensive equipment is unnecessary; the result is long lasting, and universal application is possible. Because of these facts, vaccination is, in most instances, made mandatory by law.

Prophylactic odontotomy, considered from the same standpoints, is more or less difficult of application, is time consuming, is usually more or less painful, is expensive, requires costly equipment, and is frequently unsuccessful. Because of these facts, it has not been made mandatory by law. Furthermore, universal application is not feasible, at least under any existing plan.

Any public health measure should have universal application. Does my audience for a moment believe that dentists enough or millions enough will become available to apply this operation of prophylactic odontotomy upon a universal scale? Having been a member of a state department of health for several years, I have some knowledge of the stupendous cost such a program would entail. The fact that in Pennsylvania alone there are nearly 2,000,000 school children will bring some realization of possible costs to mind.

Prophylactic odontotomy is prevention in theory. In application, it is an operation; namely, the filling of a tooth. An operation, in the usual conception of the term, is a procedure resorted to after a disease has become established; that is, the correction of a pathologic condition.

If this is so, an operation cannot be considered a preventive measure. How can operative measures be considered

Read before the Section on Children's Dentistry and Oral Hygiene at the Eighty-First Annual Session of the American Dental Association, Milwaukee, Wis., July 19, 1939.

prevention? If a disease was really prevented, any operation would be unnecessary. To operate before the disease is present is illogical.

If we are to judge prophylactic odontotomy from the standpoint of private practice, it is successful in saving that one surface of the tooth to which it has been applied if it is performed by a capable and conscientious dentist. It must be born in mind, however, that it is only the one surface that is saved. The procedure fails entirely to prevent interproximal caries. At the time Dr. Hyatt first promulgated the theory of prophylactic odontotomy, the use of the so-called bite-wing film for the detection of interproximal caries was unknown. With the constantly increasing use of this means for early detection of this type of dental decay, a new and extensive revaluation must be made. In other words, the problem of interproximal decay would loom much higher upon the horizon than it did when Dr. Hyatt first voiced the theory, years ago. New tables on tooth surface caries should be evolved.

Interproximal decay is a much greater menace to the pulp than is occlusal decay. Therefore, if we would adequately protect a tooth against caries before it has developed, we should have to insist on mesioclusodistal fillings in each bicuspid and molar tooth immediately upon its eruption.

As already pointed out, prophylactic odontotomy is not at present possible of universal application. If this is true, and since present-day accepted operative procedures are successful when properly applied, we have not advanced under the prophylactic odontotomy theory.

Many children have a natural immunity to the disease, and, in such cases, the procedure will be a waste of time, effort and money. As it is supposed to be employed before the disease has appeared, we should develop some means of determining what children possess immunity, before applying a cure.

Conservative dentists of mature judgment, with well-established practices, have only too often observed cases in which prophylactic odontotomy has been practiced upon children by over-zealous youthful dentists, usually without well-established practices. In many of these cases, the "grooves" of the occlusal surfaces, and not the "fissures," were filled. The necessities of remuneration were perhaps more carefully considered than the necessities of operative interference.

Most of us can readily call to mind many cases of abrasion and erosion in the mouths of adults of advancing years, with little or no caries present.

With our rapidly advancing knowledge of the value of adequate nutrition, both prenatal and postnatal, and of the importance of frequent and regular dental prophylaxis and the more widespread school instruction now being given in the early formation of good health habits, including home care of the mouth and teeth, we may look forward to an improved dental health status without the necessity of applying the principle of prophylactic odontotomy.

Nor are optimal nutritional requirement problems the entire story: the factors of nutritional assimilation, utilization and elimination are also of major importance.

A wise choice for the future, it would seem, would be the path of research rather than the field of operative interference.

In conclusion, I would say that experience has not justified prophylactic odontotomy. However, if Dr. Hyatt has succeeded in arousing us to an acute awareness of the necessity for earliest recognition of beginning caries, he has accomplished something of great value and of which I believe our profession is duly appreciative.

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PULP MANAGEMENT: A SUMMARY*

By KENNETH A. EASLICK, A.M., D.D.S., Ann Arbor, Mich.

SO many interesting and controversial questions have been raised by the six papers in the symposium on pulp management that it is a pleasure to attempt a summary of their statements, but difficult to refrain from taking sides. It is my purpose to review the contents of these papers as briefly as possible and to emphasize those questions that are controversial or that demand more study or research. A logical method of reviewing the entire pulp management problem, perhaps, is in the order of progressively delayed conditions. One procedure to help solve a serious problem in pulp management has been presented; another procedure, for managing a vital exposed pulp in a deciduous tooth; and a method of managing a putrescent pulp in a deciduous tooth and the postextraction steps to take when management of the pulp is no longer feasible or possible.

I. HAS EXPERIENCE JUSTIFIED PROPHYLACTIC ODONTOTOMY?

Prophylactic odontotomy has, in one paper, been defined briefly as a theory of prevention of dental caries by the filling of pits and fissures. It has been pointed out that one's understanding of success is always relative and that, in a consideration of the application of this prophylactic procedure, public health practice as well as private practice must be considered.

From a public health measure viewpoint, it has been judged a failure when compared with such a highly satisfactory preventive measure as vaccination against smallpox. Prophylactic odontotomy has been characterized as (1) difficult of proper application, (2) time-consuming, (3) more or less painful, (4) expensive, (5) demanding of expensive equipment, (6) incompletely immunizing, (7) preventive in theory, but operative in application and (8) not mandatory by law. In a second paper, the practice of prophylactic odontotomy has been compared to vaccination since it is (1) a known specific, (2) simple of application, (3) painless when performed early, (4) quick and (5) inexpensive.

From the standpoint of private practice, prophylactic odontotomy has, in the first instance, been said to be successful on one surface of a tooth only. It has been noted that many children have a natural immunity, in which case operative immunization is wasteful, and it is suggested that a method should be developed to determine the status of these immune children in advance. The criticism has been raised also that, in many cases, dentists have filled the grooves, but not the fissures, on the occlusal surfaces of young teeth. It has been stated further that the rapidly advancing knowledge of the value of adequate nutrition and regular dental prophylaxis, along with more extensive health education in the schools, will lead to improvement of dental health without the practice of prophylactic odontotomy. The conclusion has been reached that experience has not justified the practice of this measure, but realization of the necessity for early

*Summary of the papers by Drs. Harris, Wagner, Kohn, Callaway, Dwyer and Waas, presented in a symposium.

Read before the Section on Children's Dentistry and Oral Hygiene at the Eighty-First Annual Session of the American Dental Association, Milwaukee, Wis., July 19, 1939.

detection of initial caries has made the practice worth-while.

Certain questions have been provoked by these two discussions and their contrasting viewpoints indicate that the subject is controversial. The Report of the Curriculum Survey Committee, in 1935,[1] proposed a new course on the "Application of Preventive Principles," in which "remedial preventive measures" were suggested for all age periods from prenatal life to old age. Inasmuch as a partial denture may be so scientifically constructed that it prolongs the period before a full denture will be necessary, its construction becomes a preventive measure. May not any procedure which prevents a more serious subsequent procedure be considered, if not preventive, at least prophylactic, and, as so, be justifiable?

Bunting[2] has reported that only 5 per cent or less of civilized people are naturally immune to caries and that immunity may be of a temporary nature. The question may be raised, "Is it not wise to possibly err in from 3 to 5 per cent of cases through treatment of retentive fissures in all?"

Fosdick, Hansen and Epple,[3] of Northwestern University, reported a test for caries susceptibility in 1937. Hadley,[4] of the University of Michigan, reported a quantitative test in 1933; while Jay,[5] of the same school, has reported the use of this test in detail and invited dentists anywhere in the United States to make use of the faciilties of his laboratory. Another question may then be raised, "Do we not have an available method to determine immunity?"

Kronfeld and Schour[6] have stated that, on the basis of histologic examinations in which the neonatal line was used as a biologic landmark, calcification of the teeth *in utero* is not markedly influenced by a fluctuation in the condition of the mother except, perhaps, in cases of grave maternal illness or a deficiency such as osteomalacia. The question may be raised, therefore, "What can we expect to do with maternal diet as a caries-preventive measure for the child?"

Probably every dentist in private practice who works on a considerable number of children is confronted weekly by an irate mother. She has placed her child in the hands of a competent pediatrician during his first months of life and has fed him a well-balanced fortified diet ever since to the best of her ability to follow medical directions, and his teeth have decayed. Each mother of this type wants to know "Why?" Let us answer this question, "Do we in private practice get an actual cessation of caries as a result of our advice that the child eat a fortified diet unless 'sweets' are kept at a minimum?"

II. PULP TREATMENT OF DECIDUOUS TEETH

Two papers have been presented on the management of exposed and putrescent pulps in deciduous teeth, one on indications for treatment and one on contraindications. The normal retention of deciduous teeth, it has been stated, eliminates one of the reasons that we have "dental cripples." Three steps have been discussed as aids to such retention: (1) parental education to get children to the dentist before pulp treatments are necessary, (2) a technic of treatment for exposed vital pulps in deciduous teeth and (3) a technic for the treatment of putrescent deciduous teeth.

Pulp capping for the treatment of a vital exposed pulp has been rejected because of lack of success. The suggestion has been made that the necessity for the deciduous pulp to take part in root resorption reduces the chances of successful pulp capping.

Two technics for successful treatment have been given. The tooth may be anesthetized, the bulbous portion of the pulp removed and eugenol sealed in the pulp chamber. A second application of formocresol may be sealed in, and the tooth may then be filled at the third appointment with a paste of zinc oxide and

eugenol. If the operator prefers, an arsenic disk may be sealed in to devitalize the pulp; the pulp may be removed at the second appointment, and formocresol may be sealed in the canals and the tooth filled at the fourth appointment.

After the elimination of those teeth in which treatment is not indicated, it has been recommended that putrescent deciduous teeth be isolated, instruments and teeth sterilized by a 60 per cent solution of alcohol and the teeth treated three times with formocresol, and then filled in the same manner as if a pulpotomy had been performed. Dr. Sweet's rose-head bur technic has been recommended for teeth with persistent fistulae.

Two papers have discussed contraindications for the treatment of infected deciduous teeth. One paper has listed some of the difficulties involved in treatment: 1. The relation of non-vital teeth to focal infection is a controversial subject. 2. It is difficult to maintain asepsis in treatment. 3. There is a lack of instruments and supplies that have been modified for use in deciduous teeth. 4. There is no successful technic for thoroughly cleaning out and filling the canals of deciduous teeth. 5. The operator is always confronted by the hazard of failure. 6. There is the potential danger to the child's health in failure of treatment. 7. The operator is unable to state scientifically that the teeth are restored to health. 8. Simple, effective space maintainers can be placed usually in the time that is consumed by treatments.

Both papers have agreed on certain of the contraindications: the unfavorable health of the child (the papers agree that the physician's opinion should be followed in regard to the desirability of treatment); penetration of the bifurcation of the roots by caries, and resorption of two-thirds of the roots. Each paper has given other conditions which contraindicate treatment: in a fistulous opening at the gingival margin of the tooth and parapical abscess; in case there is not enough crown left to hold a filling, and in the absence of a permanent successor.

One author has summarized his position on the treatment of infected deciduous teeth in a simple statement: "Perhaps the most tenable position in dentistry today regarding the pulp-infected deciduous tooth is the treatment of some that are carefully selected and the extraction of all others."

Certain questions have been suggested by the papers on root-canal therapy for deciduous teeth. Kronfeld[7] has stated that the pulp of a human deciduous tooth takes no part in resorption. It must be recalled also that the Columbia University group reports[8] a high degree of success with pulp capping. The question may be raised, "Do we have a tenable explanation for our failures in pulp capping in children's teeth?"

Since the conservation of time is an aid both to patient management and adequate remuneration, it would be helpful to reduce the number of visits that have been outlined for the treatment of teeth with exposed vital pulps. A number of operators are using in vital teeth a pulpotomy technic in which only one appointment is required for the completion of treatment and filling. Many operators seal a devitalizing paste in at the first appointment and complete the pulpotomy, the pulp chamber filling and the amalgam filling at the second appointment. The question may be raised, therefore, "Cannot these treatment steps be reduced?"

Some of the steps in the treatment of putrescent deciduous teeth also raise a question. The drug that has been suggested for the sterilization of teeth and instruments is a 60 per cent solution of alcohol. Since the effectiveness of alcohol in securing a bacteriologically negative field has been questioned,[9] the question may be raised, "On what sterilizing agents can the operator depend to secure

a bacteriologically negative instrument?" The drug treatment that has been suggested for use in infected deciduous teeth is three successive applications of formocresol. As Sommer[10] has pointed out, there appears to be a doubtful action on the part of certain drugs toward certain strains of organisms. In some patients, bacteria in infected teeth have been found to resist a given drug, but have been killed promptly when a different drug has been sealed in. The variable resistance of the individual is still more important than the variable reaction of drugs as carried out in laboratory experiments. Another treatment question may be raised, therefore, "Is not treatment more apt to be efficient in a tooth if a rotation of drugs is used?"

Contra-indications for root-canal work have become highly controversial. Both papers stated that teeth with two-thirds of their roots resorbed should not be treated. Kronfeld[7] has stated that resorption is an intermittent process with alternate periods of resorption and repair by recalcification. Unless a series of radiograms are available to determine the original length of a deciduous root, the operator may have no way to determine how much root is gone. The question may be raised, "Of how much practical value is this fraction of root length in diagnosis, for determining treatment?"

The statement has been made that infected teeth in the mouths of children whose health is poor should always be extracted. Is this statement not an admission of inadequacy and of failure of our technics for the treatment of deciduous teeth? If operators were able to treat deciduous teeth until they were negative to bacteriologic culture and were able to seal the canals hermetically, as is now being done in scientific root-canal work for adult teeth, the question might be raised, "Would adequate treatment of putrescent deciduous teeth in unhealthy children be indicated?"

No mention has been made of bacteriologic cultures in the treatment of putrescent teeth. Hence, the statement in both papers that the physician's advice should be followed in regard to the treatment of infected teeth in doubtful cases is probably logical. Physicians are expected to have the entire health picture of the child in mind, but it is also true that most dental schools, at the present time, are training their graduates to a similar viewpoint. It is also true that many physicians are incompletely informed regarding the relation of infective foci to such conditions as arthritis. Teeth have been ordered out in adults when the joint condition was traumatic, gonorrheal, tuberculous, syphilitic, hypertrophic, menopausal or due to several other conditions which could not possibly be improved by the extraction of teeth. Many physicians still have an arbitrary attitude regarding a "dead" tooth. Extraction of teeth has been ordered regardless of the scientific skill with which they have been treated and the absence of radiographic or bacteriologic evidence for extraction. Many teeth have been sacrificed because a healthy vital tooth carried a seamless crown or because the shadow of the antrum or a mental foramen has been superimposed on the apex of a root. Another question may be raised, "Unless the average practitioner of medicine (whoever the average practitioner is) keeps himself informed, both medically and dentally, of how much value in diagnosis is his advice?"

One other contraindication for the treatment of pulp-involved deciduous teeth has been given, "the absence of a permanent successor." The reviewer is acquainted with a fellow dentist who has carried such a treated tooth for twenty-two years.

III. THE MAINTENANCE OF SPACE

The two papers on the maintenance of space have expressed the same position in regard to early loss of teeth. One has

stated that almost any space due to early loss of teeth requires maintenance; the other, that the cessation of the heart beat is the only contra-indication.

It has been pointed out that the chances for proper development are better if space maintainers are placed, and two rules have been listed for determination of the type of appliance to be used. Any type that involves the deciduous cuspid teeth must be a compensating appliance, while any that involves the posterior teeth alone may be a fixed appliance.

Ten requirements have been cited for a successful space maintainer. It should (1) maintain the space, (2) follow development, (3) restore function, (4) permit tooth motion, (5) restore the appearance, (6) aid phonation, (7) prevent tooth elongation, (8) be easily cleaned, (9) be readily removed and (10) involve no tooth cutting.

Certain conditions have been suggested wherein a space maintainer may not be necessary. If examination of a radiogram has led one to expect that the permanent tooth will erupt within six months, an appliance is not indicated. Since the permanent incisors are much larger than the deciduous incisors, it has been suggested that the "growth urge" may continue after early extraction of the deciduous incisor. In early loss of deciduous incisors, however, it is suggested that the rule of Stanton be applied and note be made as to whether the space between the mesial edges of the two lower deciduous cuspid teeth is equal to the combined mesiodistal diameter of the lower deciduous cuspid and first molar and second molar teeth.

It has been noted also that spaces are less apt to close during the time between the growth acceleration periods which precede the eruption of permanent teeth. Similarly it has been noted that the first deciduous molar space is less apt to close than the second, and a lower space less apt to close than an upper one. While a space is under observation, the patient may be dismissed with a gage for his parents to use to check the space.

The observations have been made that sharp interlocking cusps in good occlusion tend to prevent drifting, while the extrusion of an unopposed tooth is often of as much significance as loss of space. The final observation which may be considered a contraindication has been stated as absence of a permanent tooth whose space is to be closed.

Several controversial questions may be raised in regard to space maintenance. The figures of Lewis and Lehman[11] on the lateral diameter changes in the deciduous arch from 3 to 9 years indicate distinct growth differences in each deciduous molar region. The average expansion in the maxillary deciduous first molar region is 3.06 mm.; maxillary second, 1.90 mm.; mandibular first, 1.27 mm., and mandibular second, 2.12 mm. The question may be raised, "Is it a safe rule to use a fixed appliance to bind posterior teeth together?"

Both papers on space maintenance suggest the danger from extrusion of an unopposed deciduous tooth. One of our graduate students recently went through the literature in an attempt to find reports of studies of the effect of such extrusion on occlusion. He was unable to find any. "Do we know that an extruded deciduous molar will cause malocclusion?"

Another question is often raised: "How important is the complete maintenance of function of the deciduous teeth to the child's economy and permanent occlusion?" Adults have been known to go through their last three decades of life without teeth and without dentures and have maintained themselves in health. Many children go a year or longer without a permanent tooth after the physiologic loss of a deciduous tooth, and such spaces are rarely questioned. Many spaces do not close; many do, and many close and later open. The question may be presented, "Is it not sensible to take a

small impression of the postextraction space, make a simple cast and then observe the space periodically by means of this record?"

The loss of deciduous incisors has been discussed in the light of a contraindication because of the presence of a growth urge due to the formation of the larger, permanent incisors. When the occlusion of the maxillary and mandibular cuspids is considered, one is led to expect the maintenance of incisor space in the maxillae and its loss in the mandible. Some development can be credited to the occlusion of the remaining teeth, and some may be credited to hereditary growth patterns. The question may be raised, "Is the development of the permanent teeth responsible for all anterior jaw enlargement?"

The use of measurement standards tends to become mechanistic, and the operator tends to disregard individual patient variation. May not application of the rule of Stanton to anterior spaces be subject to the same criticism as the use of Bogue's Index? At one time, a number of orthodontists diagnosed as a case for treatment a deciduous arch which measured less than 28 mm. across the palate between the lingual surfaces of the second molars. Other orthodontists soon noted that wide arches might develop malocclusion, and narrow arches often did not.

A statement by Moore[12] may be interjected for the purpose of discussion:

In studying measurements of a group of developing faces, standard deviation from the mean or average during the transition period is greater for any one measurement, either of dimensions such as arch width or of time such as eruption date, than it is in adulthood when the task of assembling parts is practically accomplished. Practice based on false standards of measurement during the growth period and not on full realization of variability among growing children is definitely hazardous to the patient, particularly when it involves mechanical interference. There is no fact of nature so invariable as variation.

This summary is presented as a review of a symposium on pulp management in children's teeth. Dentistry for children has been retarded by inadequate technics, the empiric use of drugs, the insertion of temporary filling materials, the acceptance of folklore about deciduous teeth and the lack of a public health attitude toward children's dentistry. For these reasons, it behooves all clinicians and teachers to attack the problem of a children's practice critically, but with open minds. The literature on dentistry for children contains numerous controversial statements, some of which have been raised in this paper. It is hoped that they may serve as a basis for more discussion, investigation and research, resulting in professional growth.

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THE PROGRESS OF AMERICAN DENTISTRY

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NO one can reflect upon the progress of American dentistry and not be impressed with the magnitude of its accomplishments. It has within the brief space of one hundred years elevated itself to the status of a learned profession and made itself known for its excellence wherever dentistry is practiced. In addition, it has the distinction of being one of the few professions in which the world looks to the United States for leadership.

Let us consider briefly some of the steps that have led up to the present preeminence of the profession, and also some of the problems that have to be solved in the immediate future, if it is to continue in the progress that it has already made.

As one draws aside the curtain that hides from view the record of the past, he will note, first of all, that dental diseases are as old as civilization itself and are probably older, and it is only within recent years that any success has been attained in their control. Not until the sixteenth century was there any sign of the separation of dentistry from conventional medicine; and it was not until after the birth of American dentistry that any scientific progress could be said to have been made.

As we look into the history of American dentistry, we find that it had its birth when in 1630—only ten years after the landing of the Pilgrims—there were brought to the Massachusetts Colony from England three barber-surgeons. These men provided the only dental service available to the Colonists. It is reported of one of them that being sent for by a man in the neighboring settlement of Roxbury, who was suffering from toothache, he set out on his errand of mercy guided by a maid who had been sent to pilot him through a trackless wilderness, and he and his guide were overtaken by a snow storm and both perished.

There is no further record of dentistry in this country until 1735, when a man by the name of Mills, a wig maker in New York, advertised to extract teeth. From then to the opening of the nine-

Read at the Fifteenth Greater New York Dental Meeting, December 4, 1939.

teenth century, there came to these shores from Europe in increasing numbers men who were more or less versed in the art of dentistry as it was then practiced. Their number is said to have been about sixty-five. They had no dental education in the sense in which we use that term, having acquired what knowledge they possessed of the art of dentistry in the office of some practitioner of the day. There were, however, in that small group, men of vision, men who thought of dentistry in terms of health service and coveted for it a wider field of usefulness. Accordingly, under their leadership, there was organized in the City of New York, December 3, 1834, the first dental society in this country, in which men engaged in the practice of dentistry could come together for study and mutual improvement. The chief purpose of this society seems to have been the suppression of quackery. In June 1839, less than five years later, there was published the first journal in the world devoted exclusively to dentistry—the *American Journal of Dental Science.*

The next step in the evolution of dentistry was the granting of a charter, February 1, 1840, for a dental school, the first in the world; namely, the Baltimore College of Dental Surgery. This epoch-making event properly marks the birth of dentistry as a profession. It did not, however, mark the separation of dentistry from medicine, as has been frequently affirmed. That separation occurred far back in history, made inevitable by the inherent differences in practice. The founders of the first dental school did not seek to engraft dental education upon medical education by establishing a chair of dentistry in the medical school. This cannot be made too plain. Unfortunately, this legend has crept into our literature and has come to be generally believed. There is now evidence that the founders of that first dental school were firmly convinced that the public could be better served if dentistry created its own educational institutions. Rightly or wrongly, this was done.

In August of 1840, there was organized in New York the first national dental society, the American Society of Dental Surgeons, the progenitor of our present American Dental Association. Thus we see that within the brief period between 1834 and 1840—a period of less than six years—dental organization, dental journalism and dental education all had their origin. On this foundation, dentistry began the building of a profession which has now endured for a hundred years. The task which it set for itself has not yet been completed, notwithstanding the remarkable progress that has been made since that foundation was laid. Much remains to be done.

But before considering the steps that are immediately necessary to its further progress, let us pause to consider an event of transcendent importance in the early history of organized dentistry. I refer to the discovery of surgical anesthesia. The dentist of that day, oftener than the physician or surgeon, was called upon to perform surgical operations among his daily duties. Consequently, he was searching for some anodyne—something that would bring surcease from pain. Thus when Horace Wells saw the effects of "laughing gas" as administered by Colton on that December night in 1844, he quickly sensed its possibilities for the painless extraction of teeth. To test its efficacy, he took the gas himself and had one of his own teeth extracted.

Few of us realize what that meant in 1844. It required courage of a high order to inhale an unknown gas to the point of complete insensibility. What would happen if this was done? There was no one who knew the answer. Yet Horace Wells was willing to face the unknown if in so doing he might bring relief to suffering humanity. We cannot too greatly honor his memory. Riggs, who extracted the tooth and thus had the distinction of having performed the first surgical

operation under anesthesia, in writing of the event later, says:

> No one but Wells and myself *knew* to what point the inhalation was to be carried. . . . Our agreement the night previous was to push the administration to a point hitherto unknown. We knew not whether death or success confronted us. It was a *terra incognita* we were bound to explore.

Less than two years later, October 16, 1846, William T. G. Morton, a one-time pupil of Wells and doubtless familiar with his experiments, demonstrated before the Massachusetts General Hospital the anesthetic properties of sulfuric ether. Thus, there was given to the world in the brief space of two years the priceless boon of surgical anesthesia, a gift of incomparable value, from two American dentists "before whom, in all time, surgery was agony; after whom, pain in surgery was averted and annulled."

I shall not here recite the accomplishments of American dentistry since those early days nearly a hundred years ago when it embarked upon its unknown course. You are all more or less familiar with them. Instead, let me call your attention briefly to some of the unfinished tasks of the present and those also that are bound to present themselves in the immediate future. The first thing that impresses one as he surveys the present is that, notwithstanding a century of progress in American dentistry, dental ills have not been materially reduced. They are still almost universal. We have not, with all our boasted progress, learned their cause or how they can be prevented. This is not to be taken as a reflection upon the profession. Notwithstanding the millions of dollars that have been expended, the causes of cancer and the common cold still remain a mystery. As we make an inventory of the things that need to be undertaken in the century stretching before us, we agree that research should be given first place. The problem of dental care for all the people can never be solved by present methods of dental practice. Some way will have to be found for checking dental disorders at their source before anything approaching complete success can be hoped for.

And this brings up the subject of the profession's obligation to provide for a wider distribution of dental care. The importance of this is, I think, fully recognized by the profession and will play a large part in the dentistry of the future. The American Dental Association has already expressed its willingness to cooperate, under certain reasonable conditions, in any governmental effort that is made to provide dental care for those unable to provide it for themselves. The next century will, I believe, see great progress along these lines.

Dental education is another problem which, it would seem, has not been solved to the satisfaction of all. This is shown by the experiment recently made at Yale and now under way at Harvard. How shall the dentist of the future be educated to give the maximum of service? Should he be given a conventional medical education with dental training superimposed, as is the opinion of some, or shall he continue along present lines with the improvement that is sure to follow? Again, shall dentistry be broken up into groups educated on varying levels? These are some of the questions that will have to be answered as we set our faces toward the future.

Lastly, there is the problem of prevention; that is, the reduction in dental diseases that could be brought about by the systematic application to daily practice of present-day knowledge in this field, incomplete though that is. Dental diseases are unique in that they create conditions that are, to a certain extent, irreparable. Teeth, and the alveolar process which supports them, do not possess the power of self-repair. This means that early detection of disease is of supreme importance in its control. Neglect in this respect not only means an

uncertain prognosis, but also adds immeasurably to the cost. And, in these days, when much is being said about the high cost of dental service, this is a feature of the problem that should be given serious attention. I think most of you will agree that, by means already known and tried, it would be possible to lessen very materially the incidence of dental disease, and, incidentally, reduce the present cost of dental service. At the same time, this would make possible the care of a greatly increased number of people.

I am not unmindful of the fact that, in order to accomplish this, there must be greater cooperation on the part of the public. If prevention in the larger sense is ever to achieve its purpose, some way must be found to check dental diseases at their source. This we can only hope to do by a long range program of research; and since all research in dentistry (as in medicine) is carried on in the interest of the public, it is the public that should support it. This it has not done. If the public complains that, after a century of progress in dentistry, the dental ills of mankind are still almost universal, it can be said in reply that it is not itself entirely blameless. While millions have been given for research in many related fields (and wisely so), almost no part of it has been given for research in dentistry. Meanwhile, and as tangible evidence of the recognition of the importance of research, the American Dental Association has expended more than a half million dollars, all of which has been contributed by the profession itself. The problem, however, cannot be solved in this way. There must be a more general recognition on the part of the public that it too has a responsibility in the matter and that, if preventive dentistry is ever to become anything more than a dream, it must have public support. This it has never received. On this point, a writer in one of our metropolitan papers has this to say:

> If teeth are guilty of all the evils charged against them, why aren't dentists equipped to find the cause and get rid of it? The answer is that dental schools are not endowed or equipped for postgraduate and research work. They are the neglected stepchildren of science. Even the instructors for the most part practice on the side to get a living. Brilliant young men who need backing for cancer research usually find it; but who will support one who wishes to spend his life discovering the mysteries of teeth? It is a queer civilization that endows dog hospitals and will not spare the money to discover why bad teeth cripple its people.

One of the duties of the dental profession, as it girds itself for another century of service, is the education of the public to a wider appreciation of its responsibility in the field of dental research. The profession has for years carried on a campaign of education as to the importance of oral health, and ways by which the individual can help himself; but it has not stressed, as it must do in the future, the importance of research and the need for financial support. It is probably not too much to say that if intelligent cooperation along these lines could be had, it would be possible in the very near future to reduce by one-half the dental ills and the dental bills of the public. It is along this road that the future progress of dentistry lies.

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THE FLUORINE AND DENTAL CARIES PROBLEM

By GERALD J. COX, Ph.D., Pittsburgh, Pa.

DE EDS,[1] McClure,[2] Roholm[3] and others have discussed fluorine in general and with specific reference to mottled enamel. This review will consider only the facts pertinent to dental caries.

In 1931, Smith, Lantz and Smith[4] and Churchill[5] showed that the presence of fluorides in drinking water causes mottling of the enamel. Previous to this demonstration of a dental effect of fluorine in man, certain suggestions of relevance were recorded in the literature. In 1805, Gay-Lussac,[6] after the discovery of fluorine in fossil enamel by Morichini in 1802, showed the presence of fluorine in human enamel. Since then, many views concerning the functions of fluorine, especially in bones and teeth, have been reported. For example, in 1892, Crichton-Browne[7] thought "it well worthy of consideration whether the reintroduction into our diet, and especially into the diet of child-bearing women and of children, of a supply of fluorine in some suitable natural form . . . might not do something to fortify the teeth of the next generation." Only passing attention can be given to such suggestions prior to, say, 1931, interesting as they may be historically, as they were made without accurate knowledge of the fluorine content of enamel, with no proof of a difference in fluoride content of sound and of carious enamel, and with no evidence of a difference in caries incidence as correlated with the intake of fluorine. On the other hand, observations on dental caries in mottled enamel cases are of significance for at least two reasons: (1) it is now known that ingestion of fluorine is not only the cause of mottling of enamel, but is also effective in the reduction of the dental caries incidence, and (2) it is plain that fluorine alters enamel structure.

Black, with the collaboration of McKay,[8] in 1916 rediscovered mottled enamel, described the condition and observed that dental caries was less prevalent in affected areas. Bunting, Crowley, Hard and Keller[9] described observations on 103 children at Minonk, Ill., sixty-eight having mottled enamel. They said:

> In regard to the prevalence of dental caries among these children the percentage of those affected was about the same as would be found in any other community, but although caries occurred in the mouths of most children, its extent and activity were remarkably limited. The great majority of cavities consisted of small pit and fissure lesions in the molars and seldom did caries extend beyond that stage. In this respect the behavior of dental caries in the mouths of these children is distinctly different from that which usually occurs. The bacterial cultures taken from this group did not show the same correlation with the activity of dental caries as found in other communities.

McKay,[10] who had been an associate in the study of mottled enamel at Minonk, Ill., offered further data indicating that there is less caries in mottled enamel areas. Dean[11] correlated the data on dental caries and mottled enamel in three

From the Nutrition Fellowship of The Buhl Foundation, Mellon Institute.

Read before the Academy of Dentistry, Pittsburgh, Pa., March 25, 1940, and the Pittsburgh Section of the International Association for Dental Research, May 13, 1940.

areas, showing generally a reduced incidence of decay.

There are three research groups who have given evidence of three different kinds that the physiologically normal fluorine intake markedly reduces the incidence of dental caries. Armstrong and Brekhus[12, 13] found that sound human enamel averages 111 parts per million of fluorine as compared to 69 parts in the enamel of carious teeth. Dean, Jay, Arnold, McClure and Elvove[14] examined 12, 13 and 14 year old children of Galesburg, Monmouth, Macomb and Quincy, Ill., for mottled enamel and dental caries and the count of *L. acidophilus* in the saliva. The first two of these cities have water with 1.8 parts per million of fluorine and the latter two, 0.2 parts. In terms of carious teeth per hundred children, they found for Galesburg 201, Monmouth 205, Macomb 401 and Quincy 633, with the respective percentages of caries-free children 35.1, 35.1, 14.3 and 4.0. In general, the count of *L. acidophilus* was lower in the cities with the higher fluorine content of the drinking water. Cox, Matuschak, Dixon, Dodds and Walker[15] ascertained that the caries incidence in rats from mothers with sodium fluoride added to the diets up to 40 parts per million was significantly less than that of the control litters. An important point in this experimental demonstration of the unique function of fluorine is that the teeth of the young rats were formed with only the fluorine derived from the mother. After they had been weaned, all rats were placed on the same low-fluoride caries-producing diet. The data are evidence that the resistance to caries resides within the rat, presumably localized in the enamel.

Miller[16] and Hodge and Finn[17] have shown that if high levels of fluoride are present in a caries-producing diet, the incidence of caries in rats is greatly reduced. These and similar experiments on very high levels of fluoride intake may indicate possible mechanisms of the prevention of dental caries by fluorides; namely, inhibition of various phases of bacterial activity, but the extrapolation of such findings to the physiologic level is very uncertain. Bibby and Van Kesteren[18] have provided some means of bridging the gap between the toxic and physiologic dosages. They have demonstrated that oral streptococci produce in Douglas' broth containing 5 per cent of glucose with 0, 2, 10, 50 and 100 parts per million of added sodium fluoride, 3.18, 2.62, 2.34, 2.14, 1.73 and 1.48 cc. of titratable acid in twenty-four hours. Acidity in this case was titrated as $\frac{N}{10}$.

These data suggest that the activities of acidogenic organisms isolated from the mouth are definitely reduced by low concentrations of fluorides. According to Bibby and Van Kesteren, the viability of the streptococci was greatest in the highest fluoride concentrations. Similarly to Bunting, Crowley, Hard and Keller[9] at Minonk, Ill., Dean, Jay, Arnold, McClure and Elvove[14] have reported that interproximal caries, as presented by the eight susceptible surfaces of the four upper incisors, is about one-sixteenth as prevalent in Galesburg as in Quincy. Pit and fissure caries is much more comparable as to frequency. Armstrong and Brekhus[12] showed enamel from non-carious slightly mottled teeth to have 250 parts per million of fluorine, and from severely mottled teeth, with various degrees of caries, about 350 parts. In a later paper,[13] they say "teeth exhibiting severe degrees of mottled enamel and containing a considerably increased amount of fluorine may become carious." Cheyne[19] has shown that severely mottled molars of rats are subject to decay.

Atkins[20] has claimed "marked reduction in number of oral bacteria and also definite arrest of caries" in twenty cases in which water containing 5 parts per million of sodium fluoride (equivalent to 2.26 parts of fluorine) was used on a toothbrush as a dentifrice. Haygood,[21]

commenting on Atkins' work, has left doubt whether concentration is to be regarded in terms of fluoride or fluorine, indicating that the method is rather one of thorough rinsing of the mouth. He states that Atkins found a reduction of 85 per cent in aciduric cell count. At Minonk, Ill., dental caries exists[9] and the water contains 2.2 parts per million of fluorine[22]; facts which are at least contradictory to Atkins' claims, though of course the act of drinking water is quite different from rinsing the mouth.

GENERAL DISCUSSION OF THE PROBLEM

Elucidation of the mode of action of fluorine may do much to explain the process by which caries begins.

It is very generally accepted that acidogenic organisms are the excavating agents in dental caries and that they thrive best on carbohydrates. It has been shown by Jay and Voorhees,[23] by Jay[24] and by Enright, Friesell and Trescher,[25] and demonstrated by well known practical applications, that the constant presence of *L. acidophilus* in an apparently caries-free mouth prognosticates caries, but there is no proof that microorganisms initiate the process. Recognition of the difference between initiation and promotion of caries may be essential to an understanding of tooth decay. That the conditions responsible for enlargement of the cavities may be identical in every respect with those which produce the initial lesion does not lessen in any way the importance of viewing initiation and promotion as two distinct phases of caries. There is, however, evidence that initiation and promotion are distinctly different and therefore that the conception of the existence of these two stages accords with the facts.

Structural and nutritional theories of resistance to dental caries generally have suffered from lack of definition as well as from a shortage of substantiating data. In this discussion, structure refers to those characteristics of enamel, other than form, recognizable by sight or touch, with or without the aid of instruments which supplement these senses. Gross contour, such as is presented by pits and fissures, is excluded from the discussion, but the microscopic contour of tooth surfaces is one of the chief features indicated for study. Consideration of nutrition of enamel is herein limited to the preeruptive phase of tooth life.

It is a common postulate that preeruptive nutrition of a tooth can provide an enamel structure that is permanently resistant to caries. The data on fluorine and dental caries which pertain to this postulate are discussed below, and a theory of the initiation of caries through structural failure is presented.

Fluorine is the only unquestioned variant in enamel as between sound and carious teeth.[26] A fivefold variation as to this constituent has been shown by Armstrong and Brekhus[12, 13] between the enamel of "normal" decayed teeth (69 parts per million) and that of severely mottled carious teeth (350 parts). Likewise, it may also be said, without effective challenge, that fluorine is the only enamel constituent which has been proved to alter enamel structure. It is generally accepted that the fluorine which modifies enamel acts prior to or during the calcification of that tissue and that subsequent change in the fluoride content or the structure of the enamel because of continued exposure to fluorides is negligible. These facts are clear proof that preeruptive nutrition can modify both chemical composition and structure of enamel.

That the resistance of enamel to decay is not the result of chemical action in repelling bacteria is evidenced by the behavior of severely mottled enamel. Cheyne[19] has demonstrated experimentally that severely mottled rat molars are subject to caries. Armstrong and Brekhus,[12, 13] incidentally confirming the susceptibility of severely mottled enamel

to decay, have shown that the mottling of the enamel is roughly proportional to the fluorine content. But chemical action is expected to be proportional to the concentration of an active substance, and that such is the case for fluorine in inhibiting bacterial action is shown by the findings of Bibby and Van Kesteren.[18] It therefore does not appear that the fluorine of enamel protects from caries by chemical means. Volker,[27] moreover, has shown that although extensively fluorosed enamel has reduced solubility in organic acids, "it seems doubtful that the amounts of fluorine present in slightly fluorosed teeth is sufficient to alter their acid solubility."

Saliva, which has been extensively studied in relation to dental caries, undoubtedly plays an important part in the course of tooth decay. It is natural, therefore, that the inhibiting effect of the fluorides is attributed to modified oral conditions either from the drinking of fluoride-bearing waters or the immediate return of the fluorides by secretion. Or a long-period fortification of saliva can be postulated on storage of this element in the bones. The results of Bibby and Van Kesteren[18] are the best indication that local effects, through either water or saliva, or both, can be expected.

The data of Bibby and Van Kesteren[18] are concordant except for acid production in the control medium. If the values are plotted on rectangular coordinate paper, all fall on a smooth curve except that of the control. The data fall along a line on semilogarithmic paper, with the greatest deviation shown by the control. The discrepancy suggests that there is appreciable fluorine in the basic medium. I have fitted the data of Bibby and Van Kesteren to a straight line of the formula

$$V = 3.145 - 0.81668 \log (a + x),$$

in which V is the volume of $\frac{N}{10}$ alkali to neutralize acidity; a, the fluorine content of the control medium, and x, the added sodium fluoride in parts per million. This best fit by the χ^2 test indicates that the control medium contains 1.05 parts per million of sodium fluoride, equivalent to 0.48 parts as fluorine. A fitting using least squares as the criterion indicates 0.7 parts as sodium fluoride and 0.32 parts as fluorine in the basic medium. Extrapolation of the data of Bibby and Van Kesteren to lower levels of fluorine is not certain, as many substances which repress biologic activity at high levels increase it at low concentrations. Furthermore, to be applicable in explaining the difference of caries rate in mottled enamel districts, it would be necessary to show that a difference exists in the fluoride content of saliva, which is correlated with a difference in acid production by bacteria.

Cox and Matuschak have analyzed a single sample of stimulated saliva pooled from three children each from Galesburg and Quincy, finding 0.095 and 0.12 parts per million of fluorine, respectively. These meager data are admittedly of no consequence other than indicating that the salivary concentrations which must be considered lie below the level even of the control culture medium of Bibby and Van Kesteren. Furthermore, no difference of fluoride content of saliva from these cities is suggested.

McKay[28] has contended that structure plays no part in resistance to caries because mottled enamel is not more subject to caries. He has himself observed[10] less caries in mottled enamel, and the evidence of Dean, Jay, Arnold, McClure and Elvove[14] is conclusive that in mildly mottled enamel, or in the teeth of children in mottled enamel districts in which the dystrophy is questionable, there is less caries. This fact better supports the view that structure does play an important part in caries. The fact that severely mottled enamel is subject to caries is additional supporting evidence, as in that case the very poor structure suffers decay.

Dean, Jay, Arnold, McClure and

Elvove,[14] in their study of children in Galesburg, Ill., observed one group of seventy-six children who were born elsewhere and had entered the community prior to 6 years of age. The data on dental caries for these children were excluded from part of the analyses because of variations in the water histories. The permanent teeth of these children were not erupted at 6 years and hence their oral environment was identical with that of the children born in Galesburg, differing only in the preeruptive history. Consequently, they can be regarded as forming a homogeneous group so far as posteruptive exposure to water and oral conditions are concerned. The authors do not record the incidence of caries for these seventy-six children, but the number of cavities in the whole group of 319 children minus those of 243 children born in Galesburg indicates they had 174 carious teeth, or a rate of 229 per hundred children. In comparison with a group of 129 children whose teeth were normal or the mottling of which was questionable, with 240 cavities, equivalent to 186 carious teeth per hundred children, the odds are 28 to 1 that this difference does not occur by chance. Comparison of the group of seventy-six children with the 243 born in Galesburg and having 468 cavities, a rate of 194 per hundred, gives odds of 21 to 1 against chance occurrence of this difference. These analyses indicate that the oral conditions presented by drinking water or by modification of the saliva during the posteruptive period were not the factors in the protection of the teeth of the children born in Galesburg. The most logical explanation of the relative immunity of the 243 children born in Galesburg is that their teeth were resistant to caries because of structure. It is possible that there is a reduced incidence of caries in Galesburg both because of a caries-resistant structure of the enamel and because of retardation by the fluoride content of the water.

SPECULATIONS RESPECTING THE SOLUTION OF THE PROBLEM

As indicated in the foregoing discussion, I have assessed the data of the relationship of fluorine to dental caries as preponderantly supporting a theory of structural resistance to caries. But before prophylactic measures are inaugurated, further wide studies along diverse lines are indicated, in order that a thesis may be regarded as proved.[29] The value of a therapeutic use of fluorides may be found to be equally well founded in fact, but such use pertains to the fundamentally less important phase of tooth decay; namely, alleviation of present dental caries. The goal of research in dental caries should be the complete prevention of tooth decay under all normal conditions of life.

Galesburg and Quincy, as long as the former does not abandon its current source of water or the latter fluoridize the present water or change to a new source, present an incomparable field for the study of dental caries under the conditions of modern civilization. The cities are accessible; have a sufficient and homogeneous population; are quite comparable in all respects, and have no language or custom barriers. In fact, they are so typically civilized that they may not appeal to the investigator. But the thoroughly documented difference in caries prevalence demands immediate attention to all possible phases of this baffling condition.

Teeth can be obtained from Galesburg and Quincy for comparison of structure of the enamel. Certainly, in some Galesburg teeth, the mottled enamel structure should appear. If a gradation of this structure related to fluorine content and freedom from caries can be found, the facts necessary for proof of structural resistance to caries and of this function of fluorine would be at hand. The study of Galesburg and Quincy teeth with respect to enamel quality and form in the neighborhood of pits and

fissures may provide some information as to why decay in such regions of the tooth is prevalent in Galesburg, whereas interproximal decay is so greatly reduced. In any study of structure, any differences in surface features should be noted; internal conditions, such as pertain to interprismatic substance, should be studied, and the frequency of lamellae, spindles and other structures adjacent to the dentino-enamel junction should be determined.

Enamel can be prepared from teeth obtained in these cities. Comparison of rate of solubility in organic acids and the effect on oral micro-organisms correlated with fluorine content will test theories as to a chemical rôle of enamel fluorine in protection against caries.

By correlation of the fluorine content of saliva specimens with the activities of micro-organisms, data can be obtained as to whether the difference in caries rates of Galesburg and of Quincy can be ascribed to bacteriostatic or bactericidal effects. Bibby and Van Kesteren[18] indicate reduced acid production by bacteria, including *L. acidophilus,* with viability affected only by acidity. Atkins[20] and also Dean, Jay, Arnold, McClure and Elvove[14] indicate that the numbers of the organisms may be reduced by fluorides. This disagreement may be based on the *in vivo* and *in vitro* difference of study. The mouth probably offers only a slightly favorable environment for *L. acidophilus* as compared with artificial media, and fluorides in low concentrations in the mouth may be lethal. It may well be that the higher counts of bacteria are found in Quincy as compared with Galesburg because, with more and possibly greater cavities, more favorable mouth conditions exist for *L. acidophilus.* Bibby[30] has shown that tooth substance, certainly more available in a carious lesion, promotes the activities of mouth organisms. Fluorosed tooth substance was found less effective, probably because it is less soluble.

It is possible that the fluoride concentration of saliva will be found negatively correlated with calcium concentration, and possibly also the phosphate ion concentration. The greatly reduced incidence of interproximal caries in Galesburg as compared with Quincy suggests a difference in the mechanism of origin of the respective lesions. It is possible that the difference in contact of water with the teeth in question may account for this variation, but certainly the fluorine content of water should make no difference in the tendency of foods to become impacted or in the saliva distribution in the oral cavity.

Dean, Jay, Arnold, McClure and Elvove[14] confined their survey to 12, 13 and 14 year old children. If, now, their data were supplemented by a study of the teeth in Galesburg erupted before 1919, the time of drilling of the first artesian well, and those of a similar age group at Quincy, data would be available for deciding between the oral and the structural factors. The data could be supplemented with different age groups by observing teeth in Monmouth, Ill., that erupted prior to 1925, the date of drilling the first well for that city, and by comparison with equal age teeth of Quincy.

If the data from the foregoing procedure support the structural theory, study of lower age groups analyzed in view of the time of calcification would yield information on how late in tooth life fluoridization can be initiated with positive effects. If the data should support the local environment theory of protection by fluorides, this supplementary study would be without point.

Under any theory of the action of fluorine in reducing the ravages of dental caries, it is advisable that fluorides be present in water at the most effective level. If fluorides act by the formation of caries-resistant teeth, fluorine must be present continuously for the requirements of a definite age group of a normal community. If the action is by

reduction of the activities of bacteria or any other oral conditions attributable to the direct effects of the ingestion of water or to the immediate return of the fluorine *via* secretion into the mouth, fluorides must be present for all age groups. In the latter case, it would be disastrous for victims of mottled enamel to have their fluoride supply reduced to a level at which they have no protection, as their teeth then would certainly decay very rapidly.

There are certain special groups to whom it is a crucial matter whether the action of fluorine is by structural or by oral means. If structural, it would be useless to supply fluoride-bearing water to the personnel of labor groups, armies and navies. In fact, special precautions to avoid fluorine in any amount, however small, might be advisable in such cases.

Also it is important to individuals to know the mechanism of fluorine prevention of dental caries. If the mode of action is by construction of caries-resistant enamel, adults cannot expect any effects in modification of their caries status by the ingestion of fluorides. But, if the anti-caries action is through oral environment, adults may expect amelioration of tooth decay by the judicious use of fluorides. If the way in which fluorine acts is not clearly determined, harm may be done by improper applications, and the adoption of the correct practice may be delayed.

It is not enough to say that enamel structure is a factor in resistance to dental caries, but some suggestion as to how it may be effective is desirable. If resistance to caries is based on structure, initiation of caries is, by implication, a failure of structure. This suggests that mechanical forces produce the breach in the enamel that permits colonization by micro-organisms. The initial openings would be of the order of size of bacteria, and further development along the lines indicated by the usual oral environment theories. Resistance to caries then would be dependent on structural features, principally at the tooth surface, which would not yield to the ordinary forces of mastication.

Such a theory of the traumatic initiation of caries readily accounts for the varying incidence of caries. On curved surfaces, both concave and convex, irregularities in rod formation would be expected more frequently. It is at such sites that decay appears, and, as such curvatures also provide recesses, stagnation of food occurs. Because of the differences in incidence between interproximal and pit and fissure caries, some greater or lesser influence of contour itself may be included in such a theory.

It is well known that traces of impurities markedly modify crystalline structure in inorganic substance. If, to this action, is added the influence of the fluorine on the organic structures which form the enamel, it is readily conceivable that a few parts per million of fluorine can make the difference in structure that effects the difference in susceptibility to decay.

A structural theory of resistance to caries is singularly objectionable to many. It requires that steps be taken at the beginning of tooth formation to insure that the proper structures are formed and gives cold denial to the present generation of surcease from the troubles associated with dental caries. The oral environment theorists have had the field and can only assert that their procedures may arrest decay. None can claim to have prevented the initiation of caries by any procedure subsequent to the eruption of the teeth. Abstention from fermentable carbohydrates is probably only a regimen that keeps minute cavities from being enlarged to the size at which they may be detected and caries be said to exist. A caries-resistant tooth is one that does not decay under any circumstances.

No claim is made for priority in any

of the ideas proposed in this review and no field of action suggested by any of the speculations herein is reserved.

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4400 Fifth Avenue.

THE JOURNAL *of the*
AMERICAN DENTAL ASSOCIATION

L. PIERCE ANTHONY, D.D.S., Editor

Published by the American Dental Association
212 East Superior St., Chicago, Ill.

All expressions of opinions and all statements of supposed facts are published on the authority of the writer over whose signature they appear, and are not to be regarded as expressing the views of the American Dental Association, unless such statements or opinions have been adopted by the Association.

Communications intended for publication in the scientific or literary pages of THE JOURNAL should be addressed to the Editor. All advertising or business matter should be sent to the Business Manager.

Subscription is included in the annual membership dues. The subscription rate to non-members is $5.00 a year in advance, this rate applying to both domestic and foreign subscriptions. All foreign subscriptions are to be paid in United States money.

JULY *Editorial Department* 1940

ENDEMIC FLUOROSIS AND DENTAL CARIES

THE question of the caries-retarding influence of fluorides on the teeth, which is constantly being revived, should be and can be definitely answered by chemicodental researchers.

Although it has been fairly well determined that fluorine has a slightly retarding influence on the progress of dental caries, it has also been definitely shown that the deleterious influence of ingestion of fluorides on the structures of the teeth, particularly the enamel, of the child at a period when the permanent tooth tissues are in the developmental process, is too serious to be counterbalanced by its questionable caries-retarding influence at a later period.

As far back as 1915, F. S McKay, in collaboration with G. V. Black, reported the results of a scientific study and investigation of the effect of the presence of fluorides in the drinking water upon the teeth of the inhabitants of certain sections of Colorado. This investigation showed that the drinking water of these communities contained fluorides in sufficient amount to exert a decidedly deleterious effect on the structural formation of the permanent teeth, which expressed itself in mottling of the enamel.

This investigation attracted the attention of the dental profession and public health authorities, and it was not long before it was definitely confirmed that the fluorine content of the water was the positive factor in the production of mottled enamel, and that the teeth of the population of various other communities in which fluorides appeared in the water were similarly affected. It then remained to determine the amount of fluorides necessary to cause mottling of the enamel.

This phase of the problem was soon solved by establishing the fact that drinking water containing more than one part of fluorine to one million parts of water would cause mottling of the enamel. It then became a simple matter to single out the endemic areas by determining the amount of fluorine in the water of a definite area; and equally simple to avert the condition by a change in the source of the water used for drinking and cooking. Discovery and correction of the conditions that caused this distressing abnormality of the teeth constituted a distinct contribution of dentistry to the welfare of humanity.

With the definite establishment of the fact that the presence of fluorides in the water was the cause of this distressing disfigurement; with the recognition of the fact that mottling of the enamel was one of the most positive influences subversive to the esthetic ideals of dentistry; with the recognition of the desirability of eliminating fluorine from the water, and with the ways and means offered to correct the condition, we were of the opinion that the question had been settled to the satisfaction of all concerned and to the credit of dental research.

Several years ago, however, it was discovered that mottled enamel was less susceptible to caries or, more correctly stated, the process of decay was in mottled enamel apparently retarded, and this discovery has led to consideration of the use of fluorides for retardation of decay. We are happy to say, however, that such a questionable use of fluorine does not meet with the approval of the dental profession. An appreciation of the esthetic value of the teeth has been too firmly instilled in the dentist to allow him to give a second thought to the questionable value of adopting such means of retarding dental caries.

The dental profession has, at times, been criticized for its intensive development from the mechanical point of view, but one of the greatest benefits that has come to dentistry from such development, in restoring the denture to its original and natural appearance, has been a high appreciation of the esthetic value of the human dentition. At the same time, we have succeeded in developing in the public mind an equally

high appreciation of the esthetic values of the mouth and teeth, and it seems now that we shall have to inaugurate a further campaign for the education of the other health professions in order to instil in them a similar appreciation of the esthetic as well as the health values of the mouth and teeth.

Aside from the esthetic aspect, it was shown clearly by Black that it was much more difficult to satisfactorily restore mottled teeth than to restore normal teeth; that is, normal in the sense of being unaffected by mottling. This peculiarity of the structure of mottled teeth is perfectly in line with the previous findings of Black, that although the structure of the teeth did not influence particularly the rapidity of the carious process, it did have a bearing on the permanency of the restoration.

Although the later researches seem to show that the incidence of caries is somewhat less in areas where the water has a comparatively high fluoride content, 1.7 to 1.8 parts per million, it has not been determined definitely whether other mineral elements in the water have any relation to the fluoride content so far as its influence on the incidence of caries is concerned.

The original work of McKay and Black, confirmed by others, seemed to prove the case definitely, but subsequent work, notably that of Dean, again opened the case and suggested that the presence of fluorine in drinking water, even though it would cause mottling of the enamel, retarded the carious process in teeth. In this experimental work done with waters of what was considered a high and dangerous fluoride content, it was found that the content of other elements, salts of alkaline and alkaline earth metals and others, varied greatly, and the chemical significance of these elements in relation to the fluoride content and the incidence of caries has not been determined.

It would, therefore, seem that further chemical studies of the water of communities where endemic fluorosis is found will need to be made before we can be assured of the exact relation of the fluoride content of water to caries. The work done by McKay and Black is, however, sufficiently significant to assure us that the potentialities for harm from the presence of fluorine in water are much greater than those for good from the standpoint of retardation of decay.

The statement of Cox, as the result of his researches, to the effect that—so far as the influence of fluorosis on dental structure is concerned, the case has been proved—may need to be qualified, so far as the incidence of decay is involved, until further studies of the relation of the

fluoride content to other elements offer the complete solution of the problem. It has, we believe, been proved that the baneful effects on the teeth of fluorides contained in drinking water are such that we are warranted in contending for a correction of the water condition and, too, in cautioning all endemic neighborhoods to avoid the use of such water.

It appears to be a relatively easy matter to correct the water condition by a change of water supply to the community. Boiling the water will not serve the purpose, as boiling only tends to concentrate the fluorine already present and, therefore, increases the fluorine content per million parts.

Of this much, however, we may be sure: the ingestion of excess fluoride is undesirable in the tooth structure because of its mottling influence, and this undesirable and disfiguring mottling can be averted by avoiding the use of water containing a large amount of fluorides and by the proper restriction of the amount of fluorides in foods.

BIBLIOGRAPHICAL

Clinical Dental Roentgenology

Technic and Interpretation. By JOHN OPPIE MCCALL, D.D.S., F.A.C.D., Director, The Murry & Leonie Guggenheim Dental Clinic, former Professor of Periodontia, New York University College of Dentistry, Visiting Lecturer in Periodontia, New York University College of Dentistry and Consultant to the Dental Service, New York Hospital; and SAMUEL STANLEY WALD, D.D.S., F.A.C.D., Head of the Department of Diagnosis and Roentgenology, The Murry and Leonie Guggenheim Dental Clinic and School for Dental Hygienists, Assistant Professor of Roentgenology, New York University College of Dentistry, Lecturer in Dental Radiology, New York University College of Medicine, and Visiting Dental Surgeon, Nazareth Trade School. 319 pages with 1046 illustrations in 355 figures. Philadelphia and London: W. B. Saunders Company, 1940. Cloth, $5.50.

This is a brand new dental textbook, written to meet certain needs in the field of dental roentgenology. First, it is a comprehensive manual of roentgenographic technic for both the production and the processing of dental x-ray films. Second, it is a comprehensive presentation of the normal and abnormal in the teeth and their related structures in the mouth of the child, as revealed by the roentgenogram. Third, it is a detailed and, as far as possible, a simplified guide to the interpretation of dental roentgenograms. There has also been added to this book, beyond what is usually found in other books on dental roentgenology, a study of normal dentition from the prenatal period to maturity. The authors present an improved and systematized technic for the localization of impacted, supernumerary and unerupted teeth, fractured roots, teeth and cysts in the maxillary sinus and foreign bodies.

Since the authors are connected with the Murry and Leonie Guggenheim Dental Clinic of New York City and the New York University College of Dentistry, they have access to a wealth of material. They have written a book not only for dentists and dental students, but also for dental hygienists, a book well illustrated to cover every phase of the

subject of dental roentgenology. The outstanding feature of this book is the information given concerning the roentgenology of children's teeth. This phase of dental x-ray study has been greatly neglected in the past. Several chapters are devoted to the child; namely, the prenatal and the preeruptive period; early eruptive to eighth-year period, and the preadolescent to maturity period. The first period covers the period from the third month of fetal life to the sixth month of infancy. The second period covers the time from 6 months to 8 years and 6 months. The third period covers the time from 9 years 8 months to 21 years of age. This part of the book is well worth the price of the entire volume. We heartily recommend "Clinical Dental Roentgenology" to all who are interested in the technic of production and processing, and the interpretation, of dental x-ray films.

Teeth, Health and Appearance

Developed by LON W. MORREY, D.D.S., Supervisor of the Bureau of Public Relations, American Dental Association, with the assistance and approval of the committee on Dental Health Education. Approved by the United States Public Health Service; distributed by the Bureau of Public Relations, American Dental Association, Chicago, Ill. Price, $1.50.

Education of the public to the importance of oral health as an adjunct to general health has been the concern of the dental profession almost from its inception, but particularly in the past two or three decades. One of the best channels of lay education is the dentist himself, and this new book, "Teeth, Health and Appearance," is one of the best means that the dentist can employ in carrying this education to the public.

Of quarto size (10½ by 14 inches), "Teeth, Health and Appearance" is replete with beautiful colored illustrations supplemented by reading matter in large type, presenting most effectively some of the simpler problems involved in maintaining mouth health.

The size, binding and general appearance of "Teeth, Health and Appearance," as well as the style and content, lend themselves to make the book an artistic and valuable addition to the table of the dentist's reception room.

The book contains much information about the mouth and teeth and the general health that every child should have, presented through colored illustrations that cannot fail to attract and hold the attention.

The section devoted to instruction in the method of brushing the teeth should appeal to the curiosity of every child. An illustrated section devoted to present-day information on diet, vitamins, etc., should appeal to parents as well.

"Teeth, Health and Appearance" contains much elemental dental educational material that will be helpful to all dental patients.

Biomechanik der Paradentose

By KONRAD THIELEMANN. Leipsic: Meusser, 1938

Every and any kind of mechanical influence on the supporting tissues of the teeth is considered in this volume. Not only are theoretic viewpoints presented, but also practical solutions to many of the mechanical problems involved in the treatment of peridental disturbances and restorative dentistry. It seems that too much emphasis is laid on mechanical influences. One gets the impression that Nature has nothing to do but compensate for traumatic injuries. We should not forget that the supporting structures are developed according to functional influences and that they adjust themselves continuously to changes. However, we have not a mechanical, but a biologic problem to deal with, and that is why many of the problems which are solved to perfection mechanically remain unsolved in practice.

There is an extensive bibliography. The excellent pictures (242 in number) are very enlightening and the book is well printed on good paper.

BALINT ORBAN.

Public Health Dentistry and Health Security

By ALFRED J. ASGIS, Sc.B., M.A., D.D.S., Ph.D., Assistant Professor of Oral Surgery, New York University, College of Dentistry; Instructor in Public Health Dentistry, New York University, Division of General Education. Paper. 122 pages. New York: The Clinical Press, 1939.

This mimeographed volume has been designed for use in the teaching of public health

dentistry at New York University. It gives briefly the objectives and scope of this field, together with short itemized discussions of the methods of attaining the objectives. Various topics suitable for class assignment are outlined and a brief reference to the literature is included in each chapter. This volume should serve as a satisfactory class manual and guide in teaching public health dentistry.

Labio-Lingual Technic. A Description of the Labial and Lingual Appliances in the Treatment of Malocclusion

By OREN A. OLIVER, D.D.S., F.I.C.D.; RUSSELL E. IRISH, B.S., M.A., D.D.S., F.I.C.D., F.A.C.D., and CLAUDE R. WOOD, D.D.S., F.I.C.D. Cloth. 424 pages; 278 illustrations. Price $10. St. Louis: The C. V. Mosby Co. 1940.

As the text explains, this is not a complete description of the art and science of orthodontia, but is rather a detailed account of the methods used by the authors in constructing labial and lingual appliances. A step by step description is given of the technical procedures used in fashioning these arches and their retention bands. The book begins with an account of impression taking and carries the reader through the construction of bands, separation of teeth for banding, tube placement and construction of the labial and lingual appliances. Various exercises are suggested so that the book may be used as a class and laboratory guide for graduate students of orthodontia. Throughout, an attempt is made to illustrate each phase of the process described, a procedure which greatly adds to the usefulness of the volume. As a detailed and adequate account of the technical steps necessary to construct labial and lingual arch appliances, this book can be readily recommended.

Manual of Reference for Children's Dentistry

By the Dental Committee of the Health Council, Community Chest of San Francisco. Paper. Mimeographed. 48 pages with supplement. Published by the Community Chest of San Francisco, 1939.

This manual offers, in step-by-step outline, suitable procedures for the care and treatment of deciduous teeth. It is not proposed that this publication take the place of the customary textbooks on children's dentistry, but rather that it serve as a useful reference work to those agencies devoted to child welfare and public health which include adequate dental care in their programs. It should also serve dental students as a brief outline of methods of dental care, to be supplemented by outside reading. The volume contains much of interest and value, assembling and reporting pertinent current literature on the subject. It can be heartily recommended to those interested in this important field of public health work.

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President's Message

THE INNER WORKINGS OF THE AMERICAN DENTAL ASSOCIATION

NOTWITHSTANDING the fact that the American Dental Association has been in existence for more than three-quarters of a century; that it publishes a journal which goes to its membership each month giving an account of its activities, and that its annual meetings are open to all ethical dentists, many of its members are not familiar with its inner workings. Probably few of them have ever read its constitution and by-laws, in which are set forth the rules and regulations by which it is governed in its many activities. For these reasons, it may be worth while to consider briefly how it is organized, and the rules that govern its actions. This is essential to a harmonious understanding of its many responsibilities.

To begin with, it should be said that every ethical dentist in the United States is eligible to membership in the national organization, and 46,000 (in round numbers) have taken advantage of this privilege. Admission to membership is, as a rule, through the local and state dental society. Membership in one automatically makes one a member of all three. Dues paid to the local society are prorated among them, $4 going to the American Dental Association.

There is also a junior membership, which includes the three upper classes in the thirty-nine dental schools. This is a highly important provision of the Association since it encourages the student on graduation to affiliate himself with organized dentistry. Its purpose is prevention, for prevention in the field of professional ethics is quite as important as in the healing art.

The business of the Association is carried on through the House of Delegates. Each constituent society is represented in proportion to the number of its members. These representatives are elected each year by the local and state groups; which makes the House of Delegates democratic in the best sense of the word. To it are referred all matters affecting the policy and activities of the dental profession, including election of officers, standing committees, appropriation of funds and amount of dues. It is responsible to the profession and as truly representative of it as is possible.

The Board of Trustees, thirteen in number, has charge of the property and financial affairs of the Association, including the publication of THE JOURNAL, but action in all these matters is subject to the approval of the House of Delegates.

The Board is divided into three groups, of four, four and five,

each group serving for a period of three years. One group is elected annually. Regular meetings are held in connection with the annual meeting of the Association and one in February of each year. Usually, not less than three days is required for the transaction of business at each of its annual meetings. Special meetings may also be called by the President or by five members of the Board. Any member of the Association can appear before the Board and present any matter affecting the dental profession. Executive sessions of the Board are limited to Board members. Except for an occasional "off the record" discussion, all proceedings are published and are available to the members. All members of the Board serve without remuneration. They are reimbursed for traveling expenses.

The general officers of the Association are elected annually by the House of Delegates for a term of one year, except the Secretary, who is nominated by the Board of Trustees for a specified term and elected by the House of Delegates. Standing committees are also nominated by the Trustees and elected by the House. The scientific work of the Association is carried on in the sections, of which there are eight. In addition, there are three general meetings at each Annual Session of the Association, at which are presented topics of more or less general interest.

This brief outline of the many duties performed by the national organization is far from complete. The American Dental Association has been organized and is operated in the interest of the profession and the public. Into it is poured the toil, sacrifice and ideals of many of our members. Without the work which they are doing, the profession of dentistry would be the poorer. Like trade, dentistry might survive as an occupation for livelihood. It could hardly become an occupation for service.

AMERICAN RED CROSS

At this time, when the American Red Cross is engaged in raising millions of dollars for the relief of war-stricken Europe, a great opportunity is presented to the members of the American Dental Association for public spirited service. This is a cause which must appeal to the humanitarian instinct of every man and woman in the dental profession. By our contributions to this fund, we can individually have some part in mitigating the horrors of war.

We who are fortunate enough to be free from the domination of dictatorships have an added responsibility in this matter. Let us express our appreciation of our good fortune by giving generously to the Red Cross Fund.

The greatest of all humanitarians said, "Inasmuch as ye have done

it unto one of the least of these my brethren, ye have done it unto me."

In every community in the United States, appeal is now being made for contributions to this much needed fund. There is no agency in the world better fitted to administer such a fund than the Red Cross. Make your contribution direct to your local chapter and be as generous as you can.

I am at this time sending a personal message to the president of each of our state dental societies asking that they in turn get in touch with their members urging prompt action.

Let us not at this time forget that we are in very truth our "brother's keeper."

Arthur H. Merritt

BUREAU OF PUBLIC RELATIONS

AN UNSWEETENED TOOTH CANNOT DECAY!

By L. M. WAUGH,* D.D.S., F.A.C.D., New York, N. Y.

ANNOUNCER: Dr. Waugh has made many adventurous voyages to visit the Eskimos in Northern Labrador and Arctic Alaska. He has made most of these cruises in small boats and has brought back valuable information about the relation of food to the general health of the Eskimos and particularly to the health of their teeth. He could tell us, if time permitted, of dangers encountered, of pathetic and humorous experiences, but there is no story more thrilling, or in fact more important to us, than the one he will tell today of how we can prevent decay of the teeth—yes, almost without the aid of the dentist.

Dr. Waugh: Thank you. The important message that I have for every member of this radio audience this morning is that it lies within the power of nearly every one listening to prevent decay of his teeth. This can be accomplished by simple attention to diet and reasonable care of the mouth.

Listener: Dr. Waugh, before you continue, please explain in detail what diet we must maintain to prevent decay. I have the responsibility of rearing children, and I'm afraid that I may have to learn all over again how to plan meals.

Dr. Waugh: That will not be necessary. You need only to reduce the refined sugar in your daily menu. Do this and eliminate candy and you can control, and even prevent, tooth decay, which is the most common disease of

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Broadcast from Station WNYC, New York, N. Y., under the auspices of the Oral Hygiene Committee of Greater New York, April 16, 1940.

mankind. Remember this: "The unsweetened tooth does not decay."

Announcer: You call tooth decay a disease?

Dr. Waugh: A disease indeed, and a very serious one. It is the most constant and the most general disease of mankind. While it is usually not alarming at the beginning, it very often causes much suffering, and its effects may eventually spread to almost any part of the body and become so severe as to result in death. It is also man's most expensive disease, the cost of dental care in the United States alone being reliably estimated at $445,000,000 annually. This does not include the time lost by school children and grown-ups while suffering from the disease and having it treated. This, if computed, would amount to much more.

Announcer: I know, Dr. Waugh, that for years you devoted much of your time to determining the cause of tooth decay. Why did you choose the Eskimo for this study?

Dr. Waugh: Because of a statement made more than thirty years ago by Dr. Ales Hrdlička, National Museum, Washington, D. C. He said, "The primitive Eskimo is blessed with the best teeth of any known race." At his invitation, we examined his large collection of Eskimo skulls at the Museum. It then became our ambition to see the living mouth and we naturally began our studies among these peoples.

Listener: Where did you begin your study and how long did it take?

Dr. Waugh: Our study was begun in Labrador and embraced five summer cruises. On our first trip, we reached only the most southern Eskimo settlements, at Hopedale and Makkovik, and, to our utter amazement, we found not the best teeth, but the worst that we had ever seen. We determined then and there to find out why. We were told by the missionaries that tooth troubles were unknown before 1902. Then prospectors came and traded "civilized" foods to the Eskimos, wheat flour, molasses, sugar and tea. The Eskimos' native foods are seal, walrus, whale, fish, caribou, bear, trapped animals and birds and their eggs, eaten mostly raw and often frozen in winter. There are no grains and no fruits or vegetables worthy of mention, and no sugar, molasses or candy. As we cruised farther north among those regions more remote from the white man, we found the teeth to be progressively better, and, finally, when we reached Port Burwell in Ungava Bay, we found, in living subjects, the large, well-formed jaws, the regular, normally alined teeth, free from dental decay and equaling the specimens in the National Museum. In this region, we examined the mouths of seventy-six primitive, nomadic Eskimos of all ages, having 2,283 teeth with only six cavities of decay. They bought hard-tack, flour, tea and tobacco. Only a very few had ever tasted sugar, and that when they, on rare occasions, had visited the trading post. They could not afford any.

Announcer: What would you say were the most important things that you learned in your survey of five summers in Labrador?

Dr. Waugh: 1. The primitive Eskimo eating his native food does not have tooth decay. 2. When he eats "civilized" or "store" food, his teeth begin to decay just as rapidly as ours, the children being especially affected. 3. This proves that tooth health depends on the food they eat. 4. The foods traded to them by the white man when their teeth first began to decay were refined wheat flour, molasses, sugar and tea. Tea alone, it has been proved, cannot cause decay. Therefore, the exciting cause must be found in the other three; namely, refined wheat flour, sugar and molasses. 5. The missionaries told us that wheat flour, both in bulk and as hard-tack or sea biscuit, had been traded to the natives before 1884, and that, up to 1902, there had been no tooth complaints. It was when prospec-

tors and traders supplied the natives with molasses and sugar that their teeth began to decay. The disease spread so fast that, in two years, the missionaries had to send for forceps for the extraction of the natives' teeth.

The study in Labrador may be summed up as follows: The primitive Eskimo subsisting on his native diet of proteins—35 to 65 per cent—with fats making up the remainder of the diet except for a very little carbohydrate food, not any of which is fermentable, has the best teeth, with the least dental caries, of all known races. When he begins to eat "civilized" foods, there soon is a marked deterioration of the teeth and jaws. He is very fond of sweets, especially sugar, syrup and candy, and the children eat these persistently when procurable. This habit results in rapid tooth decay, almost more rapid than in white children. Eskimo teeth are often worn almost to the gum as the result of chewing tough, uncooked and gritty native foods and rawhide in making boots, clothing and harness. The older generations, reared on native foods, invariably have vastly better teeth and stronger, larger jaws than do their grandchildren who are getting "civilized" or "store" foods, which are softer.

Listener: Now you have added something besides diet. You speak of tough, uncooked foods. How does this type of food affect tooth decay?

Dr. Waugh: The chewing of these foods during childhood unquestionably promotes growth, and the development of large, strong jaws and straight teeth is the result of this. Straight teeth are less liable to decay.

Announcer: Dr. Waugh, how many Eskimos were there in Labrador?

Dr. Waugh: Approximately 800, and we studied a goodly number from every tribe. Our research was continued in Alaska at the suggestion of Dr. Hrdlička because there were about 18,000 Eskimos there. From 1929 to 1938, we made five summer cruises and one winter aeroplane trip to this far-flung country. During the first two summers, we visited the thirty-two most populous Eskimo villages of North Bering Sea and Arctic Alaska aboard the coast guard cutter *Northland*. We found conditions identical with those of Labrador, and our final conclusions were that "the American Eskimo is veritably paying for his civilization with his teeth."

Announcer: I know that you established the first bacteriologic field laboratory in Eskimo territory, in 1935. Tell us about that work.

Dr. Waugh: Our findings that summer of 1935, which were corroborated the following year when another worker accompanied us, were of the utmost importance because they proved that tooth decay in Eskimos and in whites is identical bacteriologically, the specific germs or bacteria being *Lactobacillus acidophilus* (Bunting).

Listener: Is there anything in the food or surroundings of the Eskimo that would make his teeth more naturally resistant to decay than those of any other race?

Dr. Waugh: No. That claim was thoroughly investigated with the help of the Indian Service, U. S. Department of the Interior, which financed the expedition. We were able to study native children in two primitive and one semimodern Eskimo settlement. We found that conditions ranging from lack of sunshine and home comforts, with no milk (except mother's), almost no fruits and vegetables and no grains of any kind, would, if anything, tend to make them more susceptible to tooth decay. Their good dental health is certainly not due to a superiority of native foods.

Listener: Dr. Waugh, I want to carry the message that you have given us, "An unsweetened tooth will not decay," to every person that I know, but the first question that I shall be asked will be "Can you tell us of specific cases where

tooth decay has followed the introduction of refined sugar into the diet?"

Dr. Waugh: While our study in every district, both in Labrador and in Alaska, indicated that the addition of sugar to the diet caused decay, and we have many definite records to that effect, I shall mention only three. First, in the most populous primitive Eskimo village in Alaska, where there was no trader and only a Government school and a mission, many children had been examined and no decay found, when two very primitive little natives of about 8 or 9 years appeared. They were dirty and wore only tattered primitive skin garments and yet they had decayed teeth. The teachers did not know them and we were puzzled to account for their dental condition until the missionary explained that they were nomads, their parents living far away; that he had taken pity on them, since their parents were very shiftless, and had asked a family to house them while he fed them at the mission, which he did for several months. Here, they received sweetened desserts and were given candy. The decay of their teeth was thus explained. The teeth had to be extracted.

In another large primitive village with no trader and no mission, and the only white people a Government teacher and his wife, almost no decay was found in 184 natives except in one boy about 9. His parents and four sisters had excellent teeth with no decay. This was puzzling until the teacher discovered that the boy had been taken to the trading post for a few weeks each of two summers, and, while there, he was given all the candy he could eat.

A report recently received from T. J. Pyle, dental supervisor of Alaska, is enlightening. He writes:

I do not have the exact figures yet, but I made a startling observation the other week on my annual visit to Eklutna where we have a bureau boarding school for about 115 children. I have done the work there for the past five years. It has been my habit to stop once a year to examine the children's mouths and do the necessary dental work. It is a place where I have called regularly and where the children live a well-regulated life. I have never had much work to do—usually placing between thirty and forty small fillings a year. On this visit, I found approximately 200 cavities among the same children who used to have thirty, and I did not have far to look to discover the trouble. During the past two years, the students have all earned money by making skin and ivory articles, and a year ago February some one hit upon the idea of establishing a canteen or students' store to sell them candy, fancy soap, toothpaste, etc. When I saw the enormous increase in caries, I began to inquire as to how much candy they sold, and found that in one year they sold 28,000 bars, exclusive of box candy, which was also sold in considerable amounts. When it is considered that such an increase occurred mostly among children who have been at the school several years and have lived the same during the past year as in other years, except for their higher sugar diet, it certainly appears that it was caused by the candy.

This was an increase of about 600 per cent of tooth decay in one year.

This observation is further strengthened by our most recent field laboratory findings. We went to Alaska again and selected a goodly number of primitives of all ages, fully removed from civilization, for the purpose of tabulating the effect of natural sugars and of refined sugars, syrup and candies, upon natives free of tooth decay. The ages ranged from 12 years to old age. The subjects were able to get only their native food plus what we gave them. Their mouths were free from decay and their saliva had no germs of tooth decay. They came in once daily, and each group was carefully fed in the laboratory a definite quantity of refined sugar, as follows: One group was given one candy bar (chocolate caramel and chewy); another group one lollypop, medium size, and another, cube sugar, 6 lumps. Still

another was given three preserved figs in 65 per cent cane syrup. Every native received the same amount of the same sweet each day and ate all of it. In two weeks, 88 per cent showed the presence of the specific bacteria of dental caries *(Lactobacillus acidophilus)* and, at the end of five and one-half weeks, every mouth showed tooth decay, with an average of 3.6 cavities per mouth. Understand, please, that these cavities were formed in less than six weeks in mouths of Eskimos who had never before had a decayed tooth. The only difference in their food was the addition of refined sugar.

In the parallel experiment in which natural sugar as formed in dried raisins, figs, dates and prunes was added to the diet, not one person developed any tooth decay. Therefore, natural sugar should be substituted for refined sweets as nearly as possible.

We cannot, therefore, emphasize too strongly that refined sugar, in any form, is the essential factor in decay. The longer sugar remains about the teeth, the greater the danger of decay, whether the sugar is eaten as candy, in sweet pastries and cake or sweetened breads, or as a syrup or a jam. The sticky kinds that cling about the teeth are the most harmful. The sweets become food for the bacteria which form the acids that cause decay. The sooner the mouth is cleansed after eating sweets, the less the danger. Therefore, the teeth should be cleaned and the mouth rinsed thoroughly within fifteen minutes after sweets are eaten. Candy should be eaten, if at all, immediately after meals. The habit of nibbling candy or of holding it in the mouth and letting it dissolve slowly is apt to result in decay of the teeth, with recurring dental bills. Remember that "an unsweetened tooth cannot decay" and that each one of you has it in his power to control and even prevent the decay of his teeth.

ACKNOWLEDGMENT

This broadcast would be incomplete without grateful acknowledgment to Columbia University for leave of absence and other assistance through all these years. In 1927, through a grant for research, the University financed the cruise to Labrador and Ungava Bay.

To the United States Public Health Service, Treasury Department, for having a commission to active duty and a detail to the United States Coast Guard Cutter Northland, for her Arctic cruises in 1929 and in 1930.

To the United States Coast Guard, Treasury Department, for unusual interest shown in visiting for the first time a number of Eskimo villages.

To the Indian Service, Department of the Interior, for the grants which made possible three of the research expeditions to southwestern Alaska.

To the natives, missionaries and government workers who so generously assisted. Detailed and individual acknowledgment has regularly been made to them all in the published reports.

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DENTISTRY FOR THE MENTALLY ILL PATIENT

By RALPH F. HUBER, D.D.S., Lexington, Ky.

A MENTAL patient and one of perfectly normal mind have one important thing in common: They both dread a visit to the dentist, and put it off as long as they can. However, we who work with mentally ill patients find, in most cases, that oral care has been neglected far too long. This is especially true of our patients who have been brought in from the mountains. In many instances, they are suffering from gingivitis, their gums are soft and spongy and there are large calcareous deposits. Also, their teeth are so broken and full of cavities that it is impossible to restore them, and extraction is not only necessary, but also the only thing possible. There are cases, however, in which, if the patient is not too disturbed, temporary fillings can be placed and a permanent restoration attempted.

In some cases, patients, on receiving an injection of procaine prior to an extraction, become violent, and, in cases of epilepsy, experience a seizure. With the mental patient, this is usually not due to the injection of procaine, but is due to the fact that the patient is suffering from a persecution complex. He believes that every one is trying to kill him. The numbness resulting from the injection frightens him to the extent that he believes death is imminent, and the mental upset ensues. In the case of the epileptic, the shock of the injection has merely hastened an approaching seizure. A careful check is kept on mental patients with such complexes and also on epileptics as to frequency of seizures. Nembutal or another of the barbituric acid preparations, administered beforehand, is found very helpful in such instances.

Sometimes, if the patient is greatly disturbed over the idea of going to the dentist, it is best to put off the visit for a few days, when he may become reconciled to the fact that the work must be done. Occasionally, when immediate extraction is necessary, some form of general anesthetic must be given, but this is the exception rather than the rule.

In common with a normal person, a mental patient must be made to feel that the dentist knows just what has to be done and believes that now is the time to do it. One of the best methods of gaining the cooperation of a patient, to the point where he will allow the dentist to examine and work in his mouth, is to flatter and "jolly" him. This is particularly true of women. If they have a hobby, it helps to talk to them about it and to get them to talk about it, regardless of how silly it may be. If the patient thinks that he can sing, he should be asked to sing. All of this takes time and patience, but it gains the patient's confidence and helps him forget his fears, and so is well worth while. If the mind is so far gone that it is impossible to get any kind of cooperation from the patient at any time, it becomes necessary to use a mouth gag in order to keep the mouth open and to keep the patient from biting you. Such measures are employed, however, only in the most difficult and urgent cases.

Many people believe that those who are sick mentally do not suffer as great physical pain as those whose minds are normal. This is true only in rare instances. Most of the patients react to pain just as sane people do. On the other

*From the Dental Department of the Kentucky Eastern State Hospital for the Insane.

Read at the annual meeting of the Kentucky State Dental Association, Owensboro, April 11-13, 1940.

hand, some are much more susceptible to slight pain than the average normal person is. Again, there are those who would not flinch or give any perceptible sign of pain no matter how great the suffering. Therefore, the dentist must be the judge as to the degree of pain, if any. Usually, the pupillary reflex of the eye can be used as an index.

Most of these patients require little postoperative care. Of course, a check is made of the cases, but there has been not a single postoperative infection. This is a mystery, since with negligible oral care such infection would be expected to occur frequently.

In personal habits, mental patients are so careless and unclean that the spread of Vincent's infection must be constantly guarded against. Many of them chew tobacco, and attendants must be on the alert lest the discarded chew of one patient be not immediately confiscated by another for his own use. Although the toothbrushes are kept in cabinets and collected after each brushing of the teeth, many of the patients will steal another's brush or make a friendly trade if it can be managed. Under such circumstances, it becomes evident, it is hard to keep Vincent's infection under control.

In the artificial denture cases, a difficult problem arises. Until the teeth are made, it is not known whether the patient will even attempt to wear them. Frequently, patients do wear them with very little trouble, and, more often than not, with less complaint than those who are sane. However, at any time when they are disturbed, they may try in various ways to destroy the dentures, throwing them against the wall or floors, flushing them down the toilets or throwing them out the windows. In anticipation of this, when a patient wearing false dentures becomes violent, the teeth are usually removed by the attendant and put away for safe keeping until the patient is quieter.

The dentist working on psychotic patients is often asked, "Have you ever found infected or defective teeth a factor in insanity or mental illness?" That, of course, is a problem calling for extensive research. I have had only one outstanding case of marked mental as well as physical improvement after removal of badly infected teeth, other treatments having failed. In a manic depressive case, the patient took no interest in anything or any one around him. He failed to respond to any suggestions for even the lightest forms of work or play. He would sit for hours on end in morbid contemplation and, at other times, tended to have violent mental disturbances. Within a few weeks after removal of his teeth, he began to take an interest in ward routine, talking with other patients and members of the staff. Very shortly, he was asking for some kind of work. The morbidness as well as other more severe mental symptoms disappeared, and there has been no recurrence within the six months that have since passed. Of course, the logical conclusion in this case is that the infection from the teeth was causing a physical condition which resulted in the mental illness. Granting this, the infected teeth were, in the last analysis, the basic root of the mental illness. Definite conclusions, however, are out of the question until the case has been observed for a longer time.

In many cases, especially if the patient has come from a good family, the relatives would like to think that some insidious physical condition is causing the psychosis. Frequently, it is the teeth which are suspected. As one woman told me, not long ago, concerning her 50-year-old son recently committed to our hospital, "All of his trouble started when he was teething, and was less than a year old." If the family believes that infected teeth are the cause of the condition, we make careful examinations, including roentgenograms, and do all that we can to reassure them even though we are

convinced that there is no evidence in support of such a belief.

In addition to the fact that there are many types of mental illness, with varying symptoms and reactions, the patient suffering from any one type may have a different reaction to dental work, or to anything else for that matter, each time we see him. For instance, the patient who accepted treatment docilely on one occasion will come in the next time insisting vociferously that if we so much as touch his teeth we will "ruin his religion." The next time, we may have to wait patiently while he relates all of his experiences on a recent trip to the planet Mars or Jupiter where he claims to have been born. So, with each patient, it is not a matter of treating one person, but several, and the dentist never really knows what direction his efforts must take. Therefore, the résumé here given is very general. To attempt to outline a specific or routine method of dealing with various types of dental work in cases of mental illness would be futile. For although the patient must be convinced that we know what is best for him, we must always let his reactions and state of mind guide us in our work.

DEPARTMENT OF WELFARE OF NEW YORK CITY AND PROFESSIONAL CARE

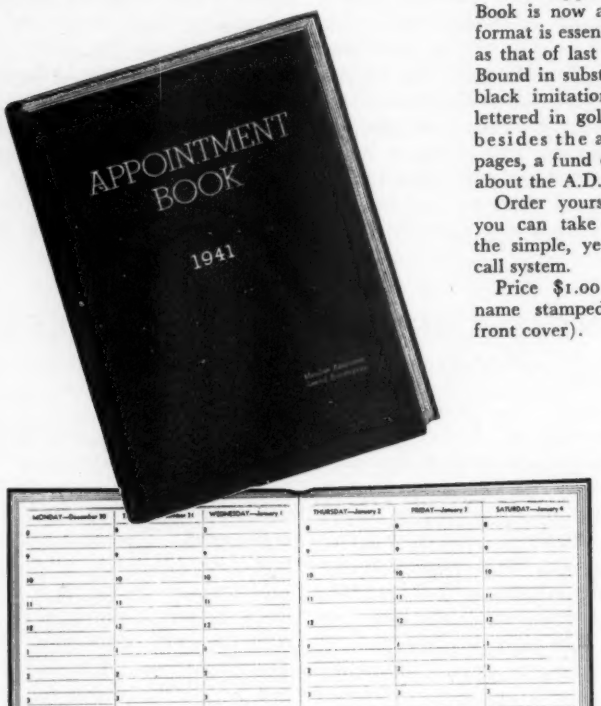
THE Department of Welfare of New York City, through its medical and nursing service, expended $1,435,944 in 1939 to provide care for an average of 26,153 persons per month. According to Commissioner Hodson, New York was the first city in the country to provide medical and nursing service in the home for relief clients. The plan and program was established with the active cooperation of the organized medical profession. Medical care is established within the pattern of private practice, and the physician is paid for each visit made. The medical and nursing service of the department is the largest of its kind in the world.

The medical services are administered by a panel of 4,800 physicians. Those desiring a place on the panel make application to the director of the division, giving professional qualifications. They are then registered with the department of welfare. Physicians may be removed from the panel for cause, by the Medical Advisory Committee. Such a removal is permanent. Physicians are paid at the rate of $2 a visit.

Dental care for adults and for children over 12 years is provided in cooperation with the WPA through a WPA project. The Department of Welfare supplements this project by paying for the necessary dental supplies and paying the salaries of the supervisory personnel and the professional personnel. Patients requesting dental care are referred to the dental clinics by the medical social worker. The present plan for providing dentures is to have them made by dental laboratories selected by the Department of Purchase. Dental care for school children under 12 years of age is provided in the school dental clinics by the Department of Health.

1941 A.D.A. APPOINTMENT BOOK

THE many members who have found the A.D.A. Appointment Book recall system helpful have requested that this year's book be published six months in advance, to facilitate booking patients who are on a six-month recall service.



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COUNCIL ON DENTAL THERAPEUTICS

DR. LYON'S TOOTH POWDER—NOT ACCEPTABLE FOR A.D.R.

Report of the Council on Dental Therapeutics of the American Dental Association, authorized for publication.

THE Council's report on Dr. Lyon's Tooth Powder was presented to the R. L. Watkins Company in order that the firm might have an opportunity to present scientific evidence bearing on the report. The firm, through its attorney, submitted a reply to the Council's report, but this reply did not contain scientific evidence that would warrant withholding the report or changing fundamentally the nature of it. The findings on the physical properties of Dr. Lyon's Tooth Powder should be considered in the light of the following remark in Accepted Dental Remedies 1939, p. 109: "However, until more information is available, the Council will refrain from drawing definite conclusions concerning the abrasive effect of dentifrices on enamel, dentin or cementum." Claims for the safety of dentifrices should nevertheless be based upon the best evidence available at present. The Council's report follows:

The Council has received sufficient requests for information on Dr. Lyon's Tooth Powder to warrant this report. These requests for information came from the profession, the laity and consumer organizations.

Over a period of several years, the R. L. Watkins Company, makers of Dr. Lyon's Tooth Powder, has employed the slogan "Do As Your Dentist Does—Use Powder." In addition to this slogan, the firm has used, and still uses, other expressions or phrases apparently designed to convey the impression that brushing the teeth with Dr. Lyon's Tooth Powder is comparable to a dental prophylaxis with respect to materials used and results obtained.

Despite a formal protest by a component society of the American Dental Association against the use of this deceptive and misleading advertising (J.A.D.A., 24:665, April 1937), the firm has persisted in the use of the slogan "Do As Your Dentist Does." Apparently, the firm has no aversion to hanging its claims on the dental profession without consulting the profession concerning the validity of such claims.

According to advertising claims, Dr. Lyon's Tooth Powder is "the preparation of an experienced practicing dentist," and is "a special dental powder developed for home use by a distinguished practicing dentist." The use of the word "practicing" might indicate that I. W. Lyon, the avowed originator of Dr. Lyon's Tooth Powder, is now in practice. Apparently, this is not true. At least, the carton bears the notation: "Established 1866 by I. W. Lyon, D.D.S." So far as the Council is aware, I. W. Lyon was not "a distinguished practicing dentist." At least, a survey of the dental literature does not indicate a basis for such a claim. It must be noted that the Council has no intention, or desire, to depreciate any contributions which I. W. Lyon, D.D.S., may have made to dentistry or to the public. The Council is, however, opposed to the practice of attributing to dentists, and especially to deceased dentists, representations regarding commercial dental articles. Neither the profession nor the public has any assurance that the representations made regarding Dr. Lyon's Tooth Powder are in harmony with the

concepts held by the originator of the product. Nor is there any assurance that the composition of Dr. Lyon's Tooth Powder, now marketed, is the same as that devised by the originator. The assertion that Dr. Lyon's Tooth Powder is a "special" preparation is unwarranted in the light of the findings of the Bureau of Chemistry. Indeed, Dr. Lyon's Tooth Powder appears to be essentially a flavored mixture of chalk and soap. The public should be informed that mixtures of this type are common and that the preparation or origination of such mixtures is not confined to "distinguished practicing dentists." Such work is best done by pharmaceutical chemists.

In recent advertising, the following may be found: "Even as a neutralizer in acid mouth conditions, Dr. Lyon's is an effective antacid." Experimental findings recorded in the scientific literature do not justify this assertion regarding Dr. Lyon's Tooth Powder or any other dentifrice.

In recent advertising, the following may be found: "It will also leave . . . your breath so sweet and pure." It is granted that the use of the product may impart to the breath temporarily the odor of oil of wintergreen. It is difficult to see how the product could sweeten and purify the breath of one suffering from a lung abscess, for example. Indeed, there is no evidence, as far as the Council is aware, that the use of Dr. Lyon's Tooth Powder can have anything but a temporary effect on the breath in any case.

Dr. Lyon's Tooth Powder is advertised as a safe dentifrice in these words: "Cannot possibly injure or scratch." and "It cannot possibly injure or scratch the tooth enamel as years of constant use have shown." In the absence of proper qualification, the first of these statements indicates that Dr. Lyon's Tooth Powder does not scratch or injure any portion of the teeth with which it comes in contact during use. This would mean that the product will not scratch or injure the enamel, dentin or cementum. As far as the Council is aware, there is no evidence that the product is harmless to the enamel, let alone to the softer portions of tooth structure, which may be exposed to the action of dentifrices.

Van der Merwe (*J. D. Res.*, 7:327, September 1927) studied the abrasive action of various dentifrices purchased on the open market. In this investigation, both teeth and bone were brushed with the dentifrices under consideration. From the results obtained, Van der Merwe concluded that Dr. Lyon's Tooth Powder is abrasive, indeed should be placed in the most abrasive group of the dentifrices studied. More recently, Repass (M.S.D. thesis, Northwestern University Dental School) studied the abrasive action of certain dentifrices on silver strips. The average weight losses sustained by the silver strip under the experimental conditions (mechanical brushing was employed) ranged from 2.4 to 124.5 mg. Only one of the dentifrices studied exceeded Dr. Lyon's Tooth Powder in abrasive effect. The weight loss produced by Dr. Lyon's Tooth Powder was 105.3 mg.

Souder and Schoonover (J.A.D.A., 24:1817, November 1937), in studying the abrasive effect of dentifrices with a view to formulation of specifications, developed a convenient test for the determination of "scratching" qualities of dentifrices. These investigators stated in effect that the abrasive weight loss tests on metal strips were not sufficiently severe to detect the presence of harsh ingredients. According to their report, however, the test on glass slides is sufficiently accurate to detect the presence of abrasives hard enough to scratch glass and consequently hard enough to scratch the softer enamel.

As can be seen from the report of the A.D.A. Bureau of Chemistry, Dr. Lyon's Tooth Powder scratches glass under the conditions of the test described by Souder and Schoonover. Since the product also

causes high weight losses on silver strips and is abrasive to both teeth and bone, the claim that "it cannot possibly injure or scratch teeth" does not appear to rest on a sound basis.

REPORT OF THE A.D.A. BUREAU OF CHEMISTRY

Six medium size (4½-ounce) cans of Dr. Lyon's Tooth Powder (The R. L. Watkins Co., New York) were purchased on the open market.

Each package consisted of a can of powder, an advertising insert and a corrugated paper liner in a paper carton.

The reading matter on the can was as follows:

Dr. Lyon's Tooth Powder. Trade Mark Reg. U. S. Pat. Off. Dr. Lyon's Tooth Powder. The preparation of an experienced practicing dentist intended solely to clean the teeth. This product is absolutely pure, containing no drugs, grit, pumice, acid or other harmful ingredients. Its regular use morning and night keeps the teeth and mouth clean and assists in keeping the gums firm and healthy. The R. L. Watkins Company, New York, N. Y., successors to I. W. Lyon and Sons, Inc., Established 1866 by I. W. Lyon, D.D.S. Container made in U.S.A.

The contents of 5 cans were bulked for analysis. The sixth can was not opened. The average net contents of the five cans opened was 131.9 gm.

The product examined was a light tan powder with a pronounced odor suggestive of oil of wintergreen.

Qualitative analysis indicated the presence of carbonate, calcium, higher fatty acid salts, sodium, phosphate, starchy material and a trace of silicious matter.

Quantitative analysis yielded the following:

Per cent calcium oxide (CaO)	51.1
Per cent carbon dioxide (CO_2)	39.2
Per cent moisture	2.1
Per cent substance insoluble in alcoholic hydrochloric acid	2.4
Per cent higher fatty acid (in terms of stearic acid)	0.87
Sulfated ash	1.254 gm./gm. sample

Examination of a paste made from a portion of the Dr. Lyon's Tooth Powder and water, by the method of Souder and Schoonover, was made. The material tested produced scratches on glass which were visible to the naked eye. Check tests on two toothpastes were made. Neither of the toothpastes examined scratched glass under the conditions of the test. (End of Bureau of Chemistry report.)

From the report of the Bureau of Chemistry, it can be concluded that Dr. Lyon's Tooth Powder consists essentially of calcium carbonate (89.2 per cent), moisture (2.1 per cent) and soap (0.9 per cent) together with flavors, starch, silicious matter and calcium phosphate.

In the light of the foregoing, Dr. Lyon's Tooth Powder (The R. L. Watkins Company) is declared not acceptable for Accepted Dental Remedies.

A copy of the rules that govern the Council in the consideration of articles will be sent on request.

HAROLD L. HANSEN, *Secretary.*

PRESCRIBING SUGGESTIONS

THE rational use of drugs and chemicals is an essential part of dental practice. Over a period of years, the Council has issued numerous reports designed to aid the dentist in the selection of drugs and chemicals of demonstrated usefulness. Many of these are National Formulary and U. S. Pharmacopoeial substances, listed and adequately described in Accepted Dental Remedies 1939. In order that the dental profession may use acceptable and official products and to the best advantage, the following formulas have been suggested.

The Council appreciates the cooperation of George C. Schicks, assistant dean of Rutgers University and chairman of the Committee on Dental Pharmacy of the American Pharmaceutical Association, in the preparation of the formulas.

SERIES VI

a)

℞	Metric Approximate Equivalents	Apoth. Equivalents
Neo-arsphenaminae	1.5 gm.	gr. xxiii
Glycerini q.s. ad.	15.0 cc.	℥ ss

M. ft. sol. amber bottle.
Sig: Apply on cotton swab three times a day.
Note: Treatment of Vincent's infection.
10 per cent solution of neo-arsphenamine.
Clean ulcerated surface with physiologic sodium chloride solution before application.
Keep in cool place protected from light.
Incompatibilities: Neo-arsphenamine quickly decomposes on contact with air and forms dangerous poisonous compounds. Decomposed by mineral acids.

CAVITY RINSE

b)

℞	Metric Approximate Equivalents	Apoth. Equivalents
*Chloroform Solution of Thymol, 50%	15.0 gm.	℥ iv
Thymol	30.0 cc.	℥ i

Chloroform q.s. ad.
*A.D.R. 1939, p. 256.

c)

℞		
Alcohol (95%)	88.0 cc.	℥ii ℥viiss
Dist. water q.s. ad.	120.0 cc.	℥iv

Note: Cavity rinse and disinfectant.
Alcohol 70 per cent.

d)

℞		
Thymol	15.0 gm.	℥ iv
Alcohol, q.s. ad.	30.0 cc.	℥ i

Note: Cavity rinse and disinfectant.
Alcoholic solution of thymol 50 per cent.

ABSTRACTS OF NOTICES OF JUDGMENT UNDER THE FEDERAL FOOD, DRUG AND COSMETIC ACT

UNDER Section 201 (n) of the Federal Food, Drug and Cosmetic Act, the following is found:

(n) If an article is alleged to be misbranded because the labeling is misleading, then in determining whether the labeling is

TABLE 1.—PRODUCTS CONDEMNED AND ORDERED DESTROYED*

N.J. No.	Name	Manufacturer	Composition
1	B. C. Headache Powders	B. C. Remedy Co. Durham, N. C.	Acetanilid, aspirin, caffeine, potassium bromide
2	Stanback Headache Powders	Stanback Co. Salisbury, N.C.	Acetanilid, potassium bromide, aspirin, caffeine, sodium bicarbonate
3	Goody's Headache Powder	Goody's Inc. Winston-Salem, N. C.	Potassium bromide, acetanilid, aspirin, caffeine
4	B-B Headache Powders	Specialty Sales Co. Atlanta, Ga.	Potassium bromide, acetanilid, aspirin, caffeine
5	Hed-Lyte	Hed-Lyte Co. Dallas, Texas	Acetanilid, sodium bromide, caffeine
6	Dixie Fever and Pain Powder	Swamp & Dixie Labs. Ft. Smith, Ark.	Acetanilid, sodium bicarbonate, caffeine, charcoal
7	E E Powders	E E Medicine Co. Greenville, S.C.	Acetanilid, acetylsalicylic acid, potassium bromide
8	Causalin	Amfre Drug Co. New York, N.Y.	Aminopyrine (aminodimethylpyrazolon), salicylic ethyl ester carbonate and a sulfonate such as quinoline-sulfonate
10	Cal-co-cin	Crescent-Kelvan Co. Philadelphia, Pa.	Calcium salts of benzoic acid and cinchophen
12	Cachets Algocratine	E. Lancosme Paris, France	Phenacetin (acetophenetidin), aminopyrine, caffeine
13	Cidic Comfort Compound	Hy'ne Co. Chicago, Ill.	Aminopyrine
14	Barmidon Tablets	Endo Products, Inc. New York, N.Y.	Barbital, aminopyrine (dimethyl-amino-anti-pyrine)
15	Anthel Tablets	Anthel Co., Philadelphia, Pa.	Aminopyrine, sal ethyl carbonate
16	Elixir Pheno Barbidon	Premo Pharmaceutical Labs. New York, N.Y.	Aminopyrine, phenobarbital
17	Tablets Sedormid "Roche"	Hoffman-LaRoche, Inc. Nutley, N. J.	Allyl-isopropylacetyl-carbamide
18	Sodasal	Sodasal Labs. Detroit, Mich.	Aminopyrine, sodium salicylate, compounds of magnesium and calcium citrates and carbonates, sugar and water.
19	Sodasal	Harry Enkel Detroit, Mich.	Acetophenetidin (approximately 8 grains per fluid ounce), sodium salicylate, a bicarbonate and small proportions of citrates, sugar and water
43	Tru-Lax Mint Flavored Chewing Laxative	Peltz-Kauffer Co., Inc. South Bend, Ind.	1 grain phenolphthalein per piece
44	Bad-Ex-Salts	E. J. Barry, Inc. New York, N.Y.	Tartar emetic

*The date of issue, May 1940.

misleading there shall be taken into account (among other things) not only representations made or suggested by statement, word, design, device, or any combination thereof, but also the extent to which the labeling fails to reveal facts material in the light of such representations or material with respect to consequences which may result from the use of the article to which the labeling relates under the conditions of use prescribed in the labeling thereof or under such conditions of use as are customary or usual.

For each of the products in the accompanying tables, judgment of condemnation was entered and the product was ordered destroyed. In each case, the Food and Drug Administration found that labeling failed to reveal material facts with respect to the consequences which might result from the use of the product under the conditions of use prescribed therein or failed to bear warnings against use under those conditions in which such use might be dangerous to health.

TABLE 2.—SURGICAL DRESSINGS SEIZED*

N.J. No.	Name	Manufacturer	Findings
59	Gauze Bandages and Absorbent Cotton	Acme Cotton Products Co., Inc., Dayville, Conn.	Adulterated, misbranded
60	Compress Bandages	Mine Safety Appliance Co., Pittsburgh, Pa.	Adulterated, misbranded
61	Gauze Bandage	Handy Pad Supply Co. Worcester, Mass.	Adulterated, misbranded
62	Absorbal Refills	Edward Girvin, D.D.S. Philadelphia, Pa.	Adulterated, misbranded
63	Gauze Bandage	Acme Cotton Products Co., Inc. Dayville, Conn.	Adulterated (product released to claimant on condition that it be relabeled "Not Sterile" or "To Be Sterilized Before Used")
64	First Aid Poc-Kits	Hampton Mfr. Co., Inc. Carlstadt, N.J.	Misbranded
65	Gauze Bandage	Ross Products Co., New York, N.Y.	Misbranded
66	Absorbent Cotton	Richmond Dental Mfg. Co. Niagara Falls, N.Y.	Misbranded

*Notices of Judgment report the seizure and disposition of surgical dressings which were in interstate commerce at the time of examination and which were found to be contaminated with viable microorganisms at that time. For each of the products listed, with the exception of N. J. No. 63, judgment of condemnation was entered and the product was ordered destroyed. (Date of issue, May 1940.)

TABLE 3.—MISCELLANEOUS PRODUCTS MISBRANDED UNDER PROVISIONS OF THE LAW APPLICABLE TO DRUGS*

N.J. No.	Name	Manufacturer	Claims	Findings
73	Lee's Milk of Magnesia Dental Cream	Trade Laboratories, Inc., Newark, N.J.	"Would make gums healthy and firm"	Claims false and misleading
		Miscellaneous		
74	Epinephrine Chloride Solution	Harvey-Pittenger Co., Philadelphia, Pa.	0.45 grains of epinephrine per fluid ounce	Claims false and misleading—contained less than 0.45 grains of epinephrine per fluid ounce

*May 1940

PINEORRHEA

PINEORRHEA (Dr. E. R. Morrison, Wilmington, N. C.), a preparation advocated for the treatment of Vincent's infection, gingivitis and pyorrhea, has been examined in the Bureau of Chemistry. From the analytic findings, it was deduced that Pineorrhea consists essentially of an acid-insoluble organic arsenical in glycerin and water.

The manufacturer has informed the Council that (a) the composition of this product is as follows: "To make 1,000 cc. Pineorrhea, forty 4.5 gram ampules Neoarsphenamine, sufficient water to dissolve Neoarsphenamine plus 50 cc. Pinsol suspended in glycerine enough to make the 1,000 cc. . . . Pinsol is pure pine oil chemically treated so as to be soluble in water . . ."; and that (b) the product has been withdrawn from the market.

ACCEPTED DENTAL REMEDIES

The Council on Dental Therapeutics of the American Dental Association announces the inclusion of the following articles in the list of Accepted Dental Remedies.

LOCAL ANESTHETICS*

Star Brand Procaine Solution 2% with Epinephrine 1:50,000: Each cubic centimeter is stated to contain procaine hydrochloride, 0.02 gm.; epinephrine, 0.00002 gm.; sodium chloride, 0.0007 gm.; chlorobutanol (chloroform derivative), 0.005 gm.; sodium bisulfite, 0.0019 gm.; in distilled water.

Manufactured by Proco-Sol Chemical Co., Inc., Philadelphia, Pa. Distributed by Star Dental Manufacturing Co., Inc., Philadelphia, Pa.

Star Brand Procaine Solution 2% with Epinephrine 1:50,000 in Cartridges.

Star Brand Procaine Solution 2% with Epinephrine 1:25,000: Each cubic centimeter is stated to contain procaine hydrochloride, 0.02 gm.; epinephrine, 0.00004 gm.; sodium chloride, 0.0007 gm.; chlorobutanol (chloroform derivative), 0.005 gm.; sodium bisulfite, 0.0019 gm.; in distilled water.

Manufactured by Proco-Sol Chemical Co., Inc., Philadelphia, Pa. Distributed by Star Dental Manufacturing Co., Inc., Philadelphia, Pa.

Star Brand Procaine Solution 2% with Epinephrine 1:25,000 in Cartridges.

DENTIFRICES†

Krest Tooth Paste.—Composition: See Craig-Martin Tooth Paste (A.D.R. 1939, p. 110).

Manufactured by Comfort Mfg. Co., Chicago, Ill. Distributed by Kresge Department Store, Newark, N. J.

*A.D.R. 1939, p. 38.
†A.D.R. 1939, p. 108.

Admission of an article to the list of Accepted Dental Remedies does not imply a recommendation. Information regarding the rules and work of the Council will be sent on request.

HAROLD L. HANSEN, *Secretary.*

RESEARCH COMMISSION

REVISION OF AMERICAN DENTAL ASSOCIATION SPECIFICATION NO. 4 FOR INLAY CASTING WAX*

By JOHN R. BEALL,† B.S., Washington, D. C.

AS a part of the program of revising existing American Dental Association specifications where, in the light of present knowledge, such revision is desirable, the revision of A.D.A. Specification No. 4 for Inlay Casting Wax was undertaken.

Comments on the existing specification and on proposed changes were solicited from dental schools, interested government agencies and manufacturers. A revised specification based on these comments and the experience obtained in testing these materials was prepared and submitted for further criticism.

The consensus of opinion was that the requirements for physical properties in the existing specification defined a satisfactory material, but that the wording of the specification could be improved to avoid any possible ambiguities in the description of the methods of testing or in the interpretation of the test data.

In view of the foregoing, the following revised specification, which follows the form of present Federal specifications, is offered. It will be submitted to the American Dental Association for official action at the national meeting in Cleveland, September 9-13, 1940.

*A Report to the Research Commission of the American Dental Association.

Publication authorized by the Executive Board of the Research Commission.

†Research Associate of the American Dental Association at the National Bureau of Standards.

PROPOSED REVISION OF AMERICAN DENTAL ASSOCIATION SPECIFICATION NO. 4 FOR INLAY CASTING WAX

A. Type.

A-1. This specification is for inlay casting wax used in making patterns which are to be used in the production of inlays. It consists essentially of waxes and hydrocarbons of the paraffin series.

A-2. The wax shall be furnished as sticks or cones, as specified by the purchaser.

B. Material.

B-1. The wax shall be uniform and free of foreign materials.

C. General Requirements.

C-1. The color of the wax shall be such as to facilitate the carving of patterns through contrast with the colors of of the hard and soft tissues of the mouth.

C-2. The wax shall soften without becoming flaky.

C-3. The wax shall not show appreciable chipping or flaking when trimmed to a fine margin at room temperature.

C-4. The melted wax when vaporized at 500° C. (932° F.) shall leave no solid residue other than carbon.

C-5. The temperature to which the wax should be heated for most satisfactory use in taking direct impressions in the dental cavity shall be indicated on each package.

C-6. A curve or data sufficient to show

the thermal expansion of the wax from room temperature to the temperature at which warpage or softening of the test specimen occurs shall be included in each package.

D. Detail Requirements.

D-1. Flow.

D-1a. The flow at 37.5° C. (99.5° F.) shall not be more than 1 per cent.

D-1b. The flow at 38.0° C. (100.4° F.) shall not be more than 5 per cent.

D-1c. The flow at 42.0° C. (107.6° F.) shall not be less than 5 per cent.

D-1d. The flow at 43.0° C. (109.4° F.) shall not be less than 50 per cent or more than 75 per cent.

E. Methods of Test.

E-1. Flow

E-1a. Specimens.—The mold used in forming the cylindrical flow specimens shall be a flat metal plate 6.0 mm. (0.236 inch) thick, containing one or more holes 10.0 mm. (0.394 inch) in diameter. This mold shall be warmed and placed on a smooth flat surface, which shall also be warmed slightly. Wax that has been heated to just above its melting range shall be poured into the mold until it is "overfilled." As the wax freezes and a shrinkage void or pipe appears, liquid wax shall be added. When the wax has lost its "mirror-like" surface, pressure shall be applied to it and maintained until the wax becomes rigid. After cooling, the excess wax shall be removed, the ends of the specimens being carved flush with the surface of the mold. The ends of the specimens shall be made plane and parallel. The specimens shall be more than 24 hours old and less than 1 week old when tested.

E-1b. Testing. The specimen shall be placed in a bath (air or water) held at testing temperature for twenty minutes prior to testing. Thin sheets of cellophane shall be placed between the ends of the specimen and the instrument used for loading. The specimen shall then be subjected to a constant load of 2,000 gm. for ten minutes at testing temperature. Change in length during the test shall be calculated as percentage of the original length, the specimen being measured at room temperature before and after test with a micrometer caliper. The change in length, in percentage, shall be reported as the flow.

E-2. Thermal Expansion.

E-2a. The linear thermal expansion characteristics of the material shall be determined by methods which will insure an accuracy such that the expansion at any temperature is correct to ±0.05 per cent of the original length of the test specimen from room temperature to the temperature at which warpage occurs. This accuracy is easily obtained through the use of a specimen 200 to 300 mm. in length.

F. Packing.

F-1. The minimum net weight of the contents shall be indicated on all packages.

F-2. Each package shall be marked with a serial number or combination of letters and numbers which shall refer to the manufacturer's records for the particular lot or batch of wax.

F-3. The date of manufacture (year and month) shall be indicated on the package as a separate item or as a part of the serial number.

BIBLIOGRAPHY

TAYLOR, N. O.; SWEENEY, W. T., and PAFFENBARGER, G. C.: Specification for Inlay Casting Wax. J.A.D.A., 18:40, January 1931.

Idem: Specification for Dental Impression Compound. J.A.D.A., 18:53, January 1931.

NATIONAL HEALTH PROGRAM COMMITTEE

AMERICAN MEDICAL ASSOCIATION AND THE SHERMAN ANTI-TRUST ACT

THE American Medical Association and its officers and other medical society officials, who were indicted for criminal conspiracy to violate the Sherman Anti-Trust Act, must stand trial on that charge. This was the effect of the action taken by the Supreme Court of the United States June 3, when it refused to review the decision of the Court of Appeals from which the medical society and officials had appealed. The Court of Appeals decision had held that the practice of medicine came within the purview of the Sherman Anti-Trust Act.

The American Medical Association and various officials were indicted in December 1938. The defendants filed a demurrer to the indictment maintaining that there was no violation of the law as charged. The District Court agreed with this contention and dismissed the indictments in July 1939.

This decision was appealed by the government and, March 4, the Court of Appeals of the District of Columbia held that the practice of medicine did come within the scope of the Sherman Anti-Trust Act. April 29, the defendants filed in the Supreme Court of the United States their petition for a writ of certiorari to review the decision of the Court of Appeals. The Supreme Court refused to review this decision by stating in effect that the defendants would have to stand trial before it would pass upon the issues involved in the case.

All of the decisions to date have had no bearing on the actual guilt or innocence of the defendants of the charges made. This will be decided at the forthcoming trial. The decisions thus far have been on the legal point of whether the actions cited in the indictment could be considered as violations of the Sherman Anti-Trust Act.

ARMY MEDICAL MOBILIZATION PLAN

A COMPREHENSIVE plan for the mobilization of America's physicians in the event of a national emergency was adopted by the House of Delegates of the American Medical Association at the annual meeting in New York, June 10. The plan in its essence calls for the organization of the medical profession in America into a nation-wide volunteer medical service corps, under the auspices of the American Medical Association, working through its component state and county units. The plan was worked out by the office of the Surgeon General of the United States Army.

"It appears," the Army medical mobilization plan says, "that in the event of a national emergency of great magnitude, it would be very necessary to conserve the medical profession. This plan would distribute the professional load and, if properly administered, should prevent the stripping of rural and isolated communities of their necessary medical personnel."

The plan proposes that the American Medical Association conduct a survey of the medical profession through its state and local components. Local societies would canvass their memberships for

volunteers and determine who would be available for military service and who for duty at home. State societies would maintain rosters of the men so selected. The War Department, Corps Areas, would then call upon the medical association for physicians or specialists. The states would be allotted quotas and these the local societies would fill. Preference would be given to reserve officers wherever their qualifications warranted.

A committee on medical preparedness was also appointed by the House of Delegates "to maintain contact . . . with all governmental agencies concerned with the prevention of disease and the care of the sick, in both civil and military aspects, so as to make available at the earliest possible moment every facility that the American Medical Association can offer for the health and safety of the American people and the maintenance of American democracy."

COMMITTEE ON LEGISLATION

A REVIEW OF THE MAIL ORDER DENTURE PROBLEM

THE mail order denture business is a relatively new form of commercial activity. It was not until about 1932 that any of these concerns achieved sufficient importance to cause public comment. By 1937 or 1938, they had probably reached their zenith in numbers, as, since that time, the number of concerns in this field has decreased considerably, and it can be expected to decrease still more. However, during the short time in which they were operating, they seem to have been very successful enterprises, at least from a financial point of view.

This success was made possible by the use of mass production methods in order to lower the price of the dentures and thereby attract a large number of customers. The prices at which dentures have been offered range from $7.50 to $87.50. Business was solicited by direct mail contacts and widespread advertising campaigns in newspapers and cheap magazines. In most cases, the appeal was directed chiefly to persons in rural districts, but a sizeable percentage of denture purchasers have been urban residents.

The procedure followed by most of these companies in obtaining a customer is essentially the same. The prospective purchaser, whether contacted by direct mail or by advertising, receives a small box containing elaborate advertising leaflets which have colored illustrations of the various priced dentures. The higher priced dentures usually have more attractive illustrations and brighter coloring, in order to impress the customer with the difference in quality.

Also included in the box is a piece of impression compound with instructions for its use. Ordinarily, the customer is advised that this piece is included merely to provide the company with a "general idea of your gums." The instructions continue: "From it we will make for you another piece of material that will exactly fit your mouth. This second piece we will send to you in the next mail. With it you can quickly take the actual impression we need for making your plates." This is the complete extent of the diagnosis of the patient's needs.

The customer is usually offered a sixty-day trial period during which he is promised that if he is dissatisfied in any way, he will be entitled to demand his money

back or to have a new set of dentures furnished free of charge. This is not quite so generous an offer as it might seem to be because even if the dentures do become uncomfortable within sixty days, which is by no means a certainty, the customer who complains will usually have trouble getting his money back. The company will offer to make alterations, give advice on the proper usage of dentures, suggest adhesives to keep the plates in place "until the mouth becomes accustomed to them" and practice numerous other dodges. If this can be kept up for sixty days, the customer loses his period of grace and is not entitled to a refund. In many cases, he gives up in disgust long before that time.

By the use of such methods as these, most of these mail order firms have had moderate financial success. A few of them have made very large profits. In some cases, their activities have had a direct effect upon the amount of work done in dental offices. This has been particularly true in smaller towns where resident dentists found that all the people in the area had received these solicitations and an appreciable number had responded. Such a situation not only meant the loss of potential customers, but also caused discussion about the disparity in the amount charged by the local dentists as compared to the advertised mail order prices.

In reality, the fees charged by the dentists were, in most cases, quite comparable to the final cost of the mail order dentures. Few persons purchased the cheaper ones and the companies used every possible device to discourage the sale of the lower priced plates. Since their more expensive dentures cost them little or no more than the cheapest, except for the price of materials, there was a wider margin of profit and a definite advantage in selling the most expensive ones.

The instinctive reaction of every dentist is that such methods of supplying dentures are fraudulent and should be prohibited. He knows that the proper procedure is detailed and complicated, requiring training and skill. He becomes even more certain of this fact when he sees examples of the dentures provided by these concerns. It is when he is making a new set of dentures for a disgruntled and dissatisfied ex-customer of the mail order companies that he has his opportunity to say "I could have told you so."

Since the use of such dentures may have injurious effects on the health, the matter is more serious than comparable schemes for obtaining money. A number of purchasers struggle along with their ill-fitting dentures, never appreciating the fact that they may soon find their mouths in such a condition that satisfactory dentures can never be made for them. Others wear dentures which are uncomfortable and cause sore spots in the mouth. Prolonged use of such dentures may cause serious conditions such as cancer of the mouth. Some find the dentures totally unsatisfactory and discard them altogether, believing that satisfactory dentures can never be made for them.

Since these conditions had a direct effect upon the physical and financial welfare of a part of the public which was not organized for action to prevent the continuation of such frauds, the dental profession, through local, state and national societies, took the initiative in making vigorous complaint and demands for action on the part of state and federal governments. The number of these denture concerns was growing and some of them were of sufficient size to constitute a serious problem.

In some states, the situation was such that the complaints were immediately acted on and the concerns were forced to cease operations in a very short time. This usually happened in those states where the mail order concerns had not gained a strong foothold and their finan-

cial condition was such that a moderate amount of pressure forced them to cease.

In other states, the profession was faced with more formidable opposition. Either because of weakness in the dental laws or because of laxity of enforcement, the mail order concerns had grown to a considerable size before any serious opposition was aroused. The owners of the concerns realized that they had hit upon a very successful financial scheme and they were willing to use all of their available funds to protect themselves. They made it difficult and expensive for the state authorities to obtain evidence against them, by avoiding advertising or solicitation of business in the state in which the concern was located. Since, in most states, the funds and personnel for enforcement of the dental laws are very meager, the state authorities had little enthusiasm for the task of eliminating these practices.

It took several years for the state societies to exhaust the possibilities of restricting these corporations under the authority of the state law, but finally it became evident that little progress could be made. In the meantime, the number of mail order concerns increased and the problem grew more serious.

Fortunately, the very circumstance that made the larger companies difficult to control upon a state basis, namely the interstate character of their business, placed them under the jurisdiction of federal agencies. This fact had been appreciated for a long time and the problem was first called to the attention of the Post Office Department in 1932, by Martin Dewey, then President of the American Dental Association. At that time, the attitude of the postal authorities was that it would be better if a victimized individual would file the complaint and prosecute the case. The difficulties inherent in this procedure made it appear more logical to attempt to have the states take action, but the possibility of federal action was never abandoned. The American Dental Association continued to demand action while cooperating with the state and local societies in their endeavor.

In November 1934, the Federal Trade Commission took its first action against persons engaged in this business by issuing a "cease and desist order" against a concern operated by a Benjamin D. Ritholz and located in Chicago. The original complaint leading up to this order was made by the American Dental Association. Several similar restraining orders against other concerns engaged in mail order activities were issued in the following months.

The effectiveness of the cease and desist order as a means of preventing the sale of dentures by mail was a disappointment. These orders prohibited the mail order concern from continuing to make the specific advertising statements covered by the order, because they had been found to be untruthful. The cease and desist orders did not prohibit the use of other statements as long as they were not substantially the same as those covered by the order, nor did they prevent the sale of dentures by mail. If the substitute statements were also untruthful, the only recourse was the issuance of a new order prohibiting the use of these statements as well as those covered by the first order.

As the ineffectiveness of the cease and desist order made it obvious that it would be an exceedingly slow and difficult matter for the Federal Trade Commission to stop the sale of dentures by mail, some action by the Post Office Department was again solicited.

By this time, a Dr. S. B. Heininger of Chicago had become one of the most prominent and most frequently criticized persons in this type of business. The Federal Trade Commission had filed a complaint against him in 1936, and he had agreed to a stipulation with the Commission, in which he admitted that he was guilty of certain of the acts

charged in the complaint and agreed to cease such practices. In spite of the restrictions imposed by this stipulation, Heininger continued to do business on what appeared to be a large scale and his advertisements appeared in a wide variety of the cheaper type of magazines.

September 22, 1937, the United States Post Office Department issued a memorandum calling upon Heininger to show cause why a fraud order should not be issued against him for "conducting a scheme for obtaining money through the mails by means of false and fraudulent pretenses, representations and promises."

The postal authorities subsequently conducted a hearing and Heininger was given an opportunity to present his case. As a result of this hearing, the Post Office Department issued an order refusing the use of the mails to Dr. S. B. Heininger, Dr. S. B. Heininger, D.D.S., Dr. S. B. Heininger, Dentist and Dr. Heininger and the Sylvan Dental Laboratory, Chicago, Illinois. He had used all of these titles in his various advertisements. According to the federal law, Heininger was entitled to appeal to a court for a review of this action of the Post Office Department, and he immediately did so.

June 3, 1938, the District Court of the United States for the District of Columbia gave its decision upon the validity of the fraud order. The opinion of the court was that the fraud order was invalid because it was based upon no substantial evidence, and that, therefore, it should not be upheld. This decision came as a great shock to the American Dental Association Committee on Legislation and caused its chairman, A. B. Patterson, to observe:

> Our state and endowed university dental departments and colleges and the American Dental Association and its many affiliated societies are all firmly of the opinion that the business of manufacturing dentures by mass production on mail order impressions which, all considered, must be sorry things, cannot be honest, and since the dentist who would attempt such general practice for profit is well aware of the unsurmountable difficulties involved, it would appear that his promises must be inherently false and his mail order business inherently fraudulent."[1]

Had this been the end of the case, it would have been a clear victory for the makers of mail order dentures. The Post Office Department, refusing to accept this decision as rightful, went to the Court of Appeals of the District of Columbia for a further review of the Department's action. The Court of Appeals, April 7, 1939, overruled the decision of the District Court, saying, in part:

> When a business is "systematically and designedly conducted upon the plan of inducing its patrons by means of false representations, to part with their money in the belief that they are purchasing something different from, superior to, or worth more than what is actually being sold," it becomes objectionable under the statutes in question, even though there is a promise to refund the purchase price should the article prove unsatisfactory. . . . The decisive factor, therefore, is not whether "anyone complains of fraud or was in fact defrauded," but whether the mails were being used to project a scheme which may result in obtaining money from the public by means of false and fraudulent statements.

Heininger's only recourse from this decision of the Court of Appeals was to ask for a final consideration of the validity of the fraud order by the Supreme Court of the United States. This appeal was duly made. October 9, 1939, more than two years after the case had begun, the Supreme Court refused to review the decision of the Court of Appeals, thereby upholding the validity of the fraud order and permitting the Post Office Department to enforce it. This meant that S. B. Heininger, under any name or guise, could not use the United States mails to sell dentures.

The outcome of this case appears to have dealt a death blow to the mail

1. J.A.D.A., 25:1151, July 1938.

order dental business. There was nothing about Heininger's business which would lead one to believe that a different decision would be reached in regard to other concerns. With the authority of the Supreme Court behind the decision that it is a fraudulent practice, it appears that any attempts of these other concerns to defend the practice would be futile.

While the Heininger case was being litigated, the other concerns were permitted to operate quite unrestrictedly because it was felt that the addition of other cases would have confused the issue and resulted in duplication of effort. Since that decision, however, there have been very definite developments. In a recent Chicago case, a federal grand jury issued indictments against a husband and wife who were proprietors of a mail order denture business.[2] The husband, John Alger, had previously been the recipient of a cease and desist order issued by the Federal Trade Commission[3] and had agreed to cease and desist certain representations which he was then making in his advertising, but this had not forced him to stop his business.

According to the evidence presented to the grand jury, the Algers had receipts of $33,816.99 in 1936 and spent $1,000 a month for advertising. The grand jury found that the witnesses against them were unable to speak clearly when wearing the dentures purchased by mail from the Algers and that the dentures did not fit properly and failed to give satisfaction. For these reasons, the jury returned the indictments for violation of the postal laws and the judge set the bond at $2,500 each. Subsequently, the defendants pleaded guilty to the charge of mail fraud and made application to the court for probation. After considering the case, the judge decided to give the defendants suspended sentences and they were placed on probation for one year.

More recently, further action against S. B. Heininger was begun when an Illinois grand jury issued an indictment against him in the same type of proceeding as that taken against the Algers. Although Heininger was not permitted to conduct his business after the Supreme Court decision, this case was based upon the fraud committed before the post office fraud order was issued. Heininger has also pleaded guilty and asked for probation. The case has not yet come to trial, but if he is convicted, he is liable to a fine or a jail sentence or both.

The action taken in these cases indicates that vigorous prosecution of all "mail order dentistry" concerns can be expected. Nearly all of the smaller concerns have ceased business rather than assume the risk of being convicted of a criminal offense. Only one concern of important size is still in business, and there will be no rest until it is forced to discontinue its activities.

It should be a source of much gratification to the profession that the United States Supreme Court has again recognized the harm that is done by combining advertising and business methods with professional service. If it were possible to furnish reasonably well-fitting dentures at a low price by this method, it could not and would not be opposed by the profession. That usable dentures cannot be supplied by mail has been proved in a number of cases. This being true, the perpetration of such frauds must be prevented. It now appears to be reasonably certain that this is being accomplished.

COMMITTEE ON LEGISLATION,
SAMUEL R. LEWIS, *Secretary*.

2. *Bull. Chicago D. Soc.*, December 22, 1939.

3. J.A.D.A., 24:1536, September 1937.

PROCESS PATENT COMMITTEE

MAY 10, the United States Circuit Court of Appeals, for the Seventh District (Illinois, Wisconsin, Indiana) affirmed the decision of the lower court holding the Webb patents invalid.

Members of the dental profession will recall that a suit for infringement was filed by George Farell Webb, of Kansas City, against an A.D.A. member in Chicago, Arnold A. Frisch, for using a bipolar electrode in the treatment of pyorrhea. Webb asserted that he was the inventor of the process, and he was attempting to collect royalties under the patent granted to him by the government. The Cameron Surgical Company was joined by Webb in his suit, as contributory infringer, because it manufactured the high frequency current generator that was used by Dr. Frisch.

For reasons explained in its annual report, the Process Patent Committee entered the case at the last moment and in an advisory capacity only. Even so, it has spent $1,500 for legal fees, and had not the Cameron Surgical Company undertaken to carry the burden of the defense, the cost to the profession might have been several times that amount. Patent litigation is expensive. The Cameron Surgical Company probably spent nearly $10,000.

The decision of the Appellate Court should convince Webb that he is wasting his money in a futile effort, but, under the law, he still has the right to start suit against any dentist in the United States who is applying a bipolar electrode to the gum tissue, except those practicing in the Seventh District, embracing the midwestern states previously mentioned, where his patent has been declared invalid. Members of the A.D.A. not residing in the Seventh District, however, need not worry as the Process Patent Committee is alive to the situation.

M. D. K. BREMNER, *Chairman,*
Process Patent Committee.

SURVEY OF DENTAL NEEDS OF ADULTS

ALL dentists who have received cards for recording the dental needs of five adult patients in connection with the survey of the Committee on Economics are urged to fill out and return the cards as soon as possible.

At the present time, every state included in the survey has been heard from and the committee is very grateful to the many dentists who have cooperated so well. To those who have not yet sent in their cards, a second appeal is directed in the hope that further cooperation can be obtained. The fact that the chosen week of the survey has passed is not of vital importance as compared with the necessity of obtaining a truly representative number of cases. Each card returned adds to the value and reliability of the survey. If any dentist has lost or misplaced his cards, new ones will be gladly sent on request.

COMMITTEE ON ECONOMICS,
American Dental Association,
212 E. Superior St.,
Chicago, Ill.

DENTAL ECONOMICS

DENTAL POSTPAYMENT PLANS AND THE PLAN IN MANCHESTER, N. H.

A FEW years ago, the dental societies of several large cities participated in the organization and operation of institutions called medical-dental service bureaus. One of the chief purposes of these bureaus was to provide facilities for arranging and handling installment payments for services which had already been rendered to the patients. The bureau staff included social workers, who investigated the patient's financial status and advised him with regard to the size of the payments that he could make and the intervals of payment. The bureau deducted 10 per cent from each installment for expenses and to establish a sinking fund for bad accounts.

These plans were supposed to have several advantages to the individual dentist: a third party handled the collection of accounts and thereby improved the percentage of collections and saved the dentist unpleasant work, and the patient's financial status was investigated by a person who had the experience and could take the time to determine the size of payment which would be the most satisfactory from the point of view of the patient's ability to pay as well as the dentists' desire to collect as soon as possible.

Among the cities adopting plans similar to these were Washington, Detroit, St. Louis, Indianapolis and Cedar Rapids, Iowa. Most of the plans are still operating, but with varied degrees of success and, in some cases, in considerably altered form. One of the early difficulties which were encountered by these bureaus was the unwillingness of a large percentage of the dentists to refer cases to the bureau. In one city, 40 per cent of the physicians and only 17 per cent of the dentists referred cases to the bureau. The reason for this difference was not very clear. It may have been based on the difference in the nature of the services; i.e., the need for medical care is apt to be urgent and the physician must provide service without an opportunity to investigate the patient's ability to pay. Under such conditions, the physician is forced to seek payment after the service has been rendered. The dentist is in a much better position to make arrangements for payment before the work is started, and it is in these negotiations that the medical-dental bureau would be of the greatest value.

Since only the larger cities have enough dentists and physicians to render the number of cases sufficient to make such bureaus financially practical, these plans could not be used in the smaller towns and rural areas. These areas have a large number of dentists who would like to take advantage of such plans if they were available, but who do not like to become involved in some of the collection schemes soliciting their accounts.

Recently, there have appeared several proposals which may achieve some success in improving the collection percentages of dentists who have difficulties in this respect and who have not within reach medical-dental bureaus or comparable programs under professional control. Some private concerns have expanded the field of collection agency activities by devising a plan for taking over the collection of accounts as soon as the dental work is completed rather than after they have become overdue. Under such plans, the company immediately pays the dentist a fixed percentage of the account, usually about 80 per cent of the

full amount, and about 5 per cent more when the account is fully paid. The 15 per cent remainder goes to the company as a fee for its services.

There can be a considerable number of variations based on this general pattern, but the basic procedure would be approximately the same. If the patient refuses or is unable to pay, the dentist will, of course, be charged according to the expense of attempting to collect the account and, under some plans, he may have to refund the original payment as well. It is obvious that the finance company will protect itself against all possible losses, and if the patient fails to pay, the dentist must bear the loss.

Another recent addition to the organizations engaged in collecting medical and dental accounts is the commercial bank. The banks have entered the field of personal loans in an effort to put idle funds to work, and the financing of dental and medical care has been considered a good source of potential business. In several communities, the banks have advertised to the general public that loans are available, at reasonable rates, for meeting the cost of dental and medical care.

An interesting account of a plan of this type which has been developed in Manchester, N. H., has been sent in by T. Carroll Sullivan of that city. This plan utilizes the facilities of the local banks in the following manner:

John Doe needs $100 worth of dental service. He wants to pay for it on the basis of $2 a week. The dentist calls his bank, and gives the prospective patient's name and address. The bank looks him up, and if he is a good risk, in the opinion of the bank, he will be asked to sign a note agreeing to pay the bank $2 a week for fifty weeks or until the bill is paid. The dentist will receive the $100 immediately. If the patient agrees to pay this money back within a year, it will cost him $6 per hundred dollars for a year. This $6 will take care of the carrying charges, bookkeeping and collecting for a year. The bank will let him have any sum ranging from $25 to $500. The cost of its money and service to him will depend on how long he wishes to take to pay back this money.

Now let us say that John Doe, in the eyes of the bank, is just a fair risk. The dentist, if he is willing to take a chance on John Doe's paying his debts, may do so by becoming the co-signer of John Doe's note; i.e., the dentist and John Doe sign the note at the bank. The dentist is now responsible for the money from the bank. He does not, however, have to let John Doe know that he is responsible. In order to protect himself and the bank when the bank hands over the money to him, he should immediately deposit the money in that bank in a savings account and leave the bank book with the bank.

The dentist immediately starts to draw interest on this money in his account. He has furnished himself and the bank with protection against this note that he is responsible for. He is starting to build collateral in a bank where perhaps he has never had any. He is starting a savings account, which every one should have. This money is ready to be used by him in case something unforeseen happens and the patient does not complete payment on the note. This is not likely to happen, however, inasmuch as a bank does not lose, on an average, as much as 2 per cent of any of its accounts. It is its business to collect and handle money—not the dentist's. The bank can put the pressure on delinquents in a much nicer and more effective way than an ordinary creditor can. Also, people want to keep their credit good in a bank because they can then get money again when they need it. If the patient, in spite of all this, pays only half of his debt, the dentist draws half out of his account and pays it to the bank, keeping the other half. If he pursues this plan, after two years or less, he will have accounts coming due in such a way that he will have money ready to be drawn out of the bank every month if he desires to withdraw it.

The bank advertises by the year in newspapers. They pay for this space by the year. This advertising is done to increase business in the bank. The plan outlined represents new business for the bank. The bank, therefore, decides to advertise this plan in the newspapers at its own expense. We cannot advertise dentistry, as such, but the bank

can advertise the fact that it has money available for use in buying dental service. Our plan then is constantly before the public. This plan we believe is not only going to work to the advantage of bank, patients and dentists, but also is going to help to develop respect among the three groups, as it is ethical, clean, business-like and, above all, fair to all parties concerned.

The plan certainly has a number of interesting aspects and, on its face, seems to present a method of financing dental service at a smaller cost than any of the other plans can provide. Another advantage is the fact that banks are much more accessible to the majority of dentists than private finance companies.

What remains to be seen is whether dentists will use the plan to a greater extent than some of the others. The advertising done by the banks will aid in acquainting the public with the service. The favorable reputation which most banks have, plus the relatively low interest rates, should also be an asset.

Terminal Square, Cleveland, Ohio.

American Dental Association Eighty-Second Annual Session

CLEVELAND, OHIO, SEPTEMBER 9-13, 1940

THE Eighty-Second Annual Session of the American Dental Association will be held in Cleveland, Ohio, September 9 to 13 inclusive, and from all indications "If" will be the keynote of this annual meeting of the best dental minds.

Planning the most comprehensive scientific program in the history of the profession, the Cleveland local arrangements committee announces that all association members should attend the September convention

If they want answers to dental questions.

If they want to improve their practice.

If they want to hear about recent developments.

If they want to see the latest technics.

If they want to learn the advances in materials.

If they want to see new improvements in equipment.

If they want to meet old friends and acquaintances.

There will be no "If," however, in regard to the success of the Cleveland meeting.

In the first place, the convenient location of Cleveland, "The Genial Host to the World," promises one of the largest attendances in the history of the A.D.A. meetings. A registration of 10,000 is expected.

In the second place, Cleveland feels that it must equal or outdo, if possible, the very successful Baltimore Centenary Meeting, which brought international attention during March to the hundredth anniversary of American dentistry as a profession.

Cleveland meeting officials announce that approximately 125 scientific, health, historical and miscellaneous exhibits will be on display in the Auditorium. If this figure is reached, it will approach if not pass the record for other A.D.A. meetings.

The historical exhibits will recount the development of dentistry in the last hundred years, offering a review of the recent Baltimore celebration for those dentists who missed the centennial observance in the Maryland city.

The central location of Cleveland is also expected to invite a near-record number of commercial exhibits.

While Cleveland officials are expecting to break records, their primary concern is the scientific phase of the convention. Each scientific section chairman has done his utmost to have on his program the authorities in the respective branches of dental practice. The visual education programs (motion pictures) and the clinics will also cover every phase of dentistry.

American Dental Association

Cleveland, Ohio September 9-13, 1940

HOTEL RESERVATIONS

To secure hotel accommodations for the 1940 Session, consult the rate list below and fill out the attached blank. Mail this immediately to the hotel of your choice or to the Housing Committee, Room 1241, Hotel Statler, Cleveland, Ohio. Confirmation will be sent to you by the hotel.

Second and third choices of hotel should be indicated. If the reservation cannot be made at any of the hotels of your choice, the Housing Committee will place you in as favorable a hotel as possible and will notify you.

Please remember that a reservation constitutes a contract with the hotel to provide you with the accommodations you desire. If you find it impossible to carry out your part of the contract, namely, to occupy the room at the time agreed upon, please write or wire the hotel releasing the room, in order that it may be available for other members.

APPLICATION FOR HOTEL ACCOMMODATIONS

AMERICAN DENTAL ASSOCIATION

Cleveland, Ohio. September 9-13, 1940

HOTEL.....1st choice

HOTEL.....2nd choice

HOTEL.....3rd choice

Kindly reserve the following: ☐ Single room ☐ Double room ☐ Twin beds.

.....rooms without bath for.....persons $.....per room

.....rooms with bath for.....persons $.....per room

Arriving on September.....at.....a.m.....p.m.

ROOMS TO BE OCCUPIED BY:

NAME	ADDRESS IN FULL

NOTE TO HOTEL NAMED AS FIRST CHOICE: If the hotel of first choice is unable to make the reservation requested, this application should be forwarded at once to the Housing Committee, Room 1241, Hotel Statler, Cleveland, Ohio.

SCHEDULE OF RATES

ALL ROOMS WITH BATH*

Hotels	Single	Double	Twin	Suites
ALCAZAR HOTEL Surrey & Derber shire	$3	$5		$12–16
ALLERTON 1802 East 13th Street	2.50–3	4.50	5–5.50	
AUDITORIUM HOTEL E. 6th at St. Clair	2.50–3–3.50–4	4.50–5–5.50	6–7	
BOLTON SQUARE Carnegie at E. 89th St.		5	6	
CARTER HOTEL Prospect near 9th St.	2.75–3–3.50–4	4–5–6–7	6–7–8	12–19
CLEVELAND HOTEL Public Square & Superior St.	3–3.50–4–4.50	4.50–5–6–6.50	6–7–8–9–10	22–30
FENWAY HALL Euclid at University Circle			6–7	10–12
GARFIELD HOTEL Prospect at 38th Street	2.50	3		4–6
HOLLENDEN HOTEL Superior at 6th St.	3–3.50–4–4.50–5–6	5–5.50–6–6.50–7	6–6.50–7–8–10–12	12–40
LAKE SHORE 12506 Edgewater Drive				10–12
MECCA HOTEL 1862 East 9th Street	2	3.50–4		
OLMSTED HOTEL Superior at E. 9th St.	3	6–7	7	9–10–15
REGENT HOTEL 10539 Euclid Avenue		3	5	
STATLER HOTEL (Headquarters) Euclid at 12th	3–3.50–4–4.50–6	5–5.50–6–6.50–7–8	5–5.50–6–6.50–7–7.50–8	10–15
STERLING HOTEL Prospect at E. 30th St.		5	6	
SOVEREIGN 1575 East Boulevard		5–6	8	
STOCKBRIDGE HOTEL 3328 Euclid Avenue	2	3	4	
TUDOR ARMS Carnegie & 107th St.	3–3.50	5.50	6	7–12–20–30
WADE PARK MANOR E. 107th & Park Lane	3.50–4		6	8–10–12–15
WESTLAKE Blount Street	3.50	6		12

*Rate on rooms without bath by request.

Hotel Statler, Cleveland, Ohio, Headquarters, Eighty-Second Annual Session of the American Dental Association, September 9-13, 1940.

NEW HARVARD SCHOOL OF DENTAL MEDICINE

THROUGH gifts of $1,300,000 already made toward a required total of $1,550,000, Harvard University will inaugurate in 1941 an entirely new five-year course in dental education. This course will combine the basic knowledge and skills of both medicine and dentistry and is designed to train new types of scientific workers for the attack on the great public health problem of dental disease.

Harvard was the first university in America to establish a dental school and becomes the first university to institute this particular plan in the development of dental and medical education.

This new development has been made possible by the gift of $650,000 from the Carnegie Corporation, $400,000 from the Rockefeller Foundation, and $250,000 from the John and Mary R. Markle Foundation. A balance of $250,000, bringing the total to $1,550,000, is required to fulfill the program; but the University announces it has sufficient expectation of finding a means to provide this balance to proceed with the entire plan.

The President and Fellows of Harvard College have also transferred definitely to the resources of the School of Dental Medicine $1,000,000 tentatively placed at the disposal of the Dental School ten years ago. The permanent new assets for teaching and research in dentistry in Harvard thus total $2,550,000.

According to President Conant

The new program contemplates a more complete and formal integration of dental and medical education than has heretofore been attempted in this country. It is a move in the direction of attacking the great public health proolem of dental disease at its source —through advancement of the study of causes of such disease and of its prevention. It is hoped that through the plan, the scope of adequate dental protection may be extended to large numbers of our people for whom dental attention is not now available.

Under the new program, the Harvard Dental School will be renamed the Harvard School of Dental Medicine. Dental students will register in both the new School of Dental Medicine and in the Harvard Medical School, taking three and one-half years of the same medical courses as other students in the Harvard Medical School, and in addition one and one-half years of specific dental training. Graduates will receive both the M.D. and D.M.D. degrees. Admissions to the School of Dental Medicine will be governed by the same standards and the same committee which govern admissions to the Harvard Medical School.

In explanation of this important and pioneering change, President Conant said:

There are now some 70,000 practicing dentists in the United States. In general the profession of dentistry in the one hundred years of its existence has established remarkable standards of proficiency and service. The precision and ingenuity of reparative methods developed by its leaders and members has been extraordinary.

Yet the problem of proper dental protection for our population as a whole has only been partly solved.

It is stated by the Committee on Economics of the American Dental Association that the 70,000 dentists now practicing, devoting their entire time to the care of patients, could not give adequate dental care to more than 20 per cent of our people. This would leave 80 per cent who receive insufficient attention, a serious proportion, since dental maladies are more or less universal and are at times widely detrimental to general health.

It hardly seems likely that economic resources will permit multiplying the present provision for dental care by five. Moreover, the provision of such increased care, even if financially feasible in the near future, would not be a real solution of the problem. The real solution would appear to be in advanced knowledge of the causes of dental disease,

and resultant improvements in the methods for preventing such disease.

It is to this type of solution, with the wide human benefits involved, that it is hoped the new Harvard School of Dental Medicine may make its contribution. Without sacrificing the skill and expertness attained under present methods of dental education, the new program will attempt to add to the dentist's equipment a wider and deeper knowledge of medicine, and hence a more favorable background for the advancement of study of essential causes and preventive method.

Several foundations, long deeply interested in dental education and research, have contributed generously to the Harvard program. The Carnegie Corporation's gift of $650,000 is in addition to an earlier gift of $350,000, made in 1937. Thus the total contributions of this foundation to dental developments at Harvard amount to $1,000,000. The gift of the Markle Foundation is for the support of dental research, for which a previous gift of $25,000 was made, bringing total gifts from this foundation to $275,000. The Rockefeller Foundation has added still further to its Harvard benefactions by a gift of $400,000 to the new School of Dental Medicine.

Under the plan, the last class to enter the present four-year dental curriculum at Harvard will be admitted this coming September. The new program will go into operation in the fall of 1941.

This development is a natural continuation of the close and essential relationship between the two professions which has been stressed for many years by the Harvard staff. Five years ago, Harvard founded a University Committee on Research in Dental Medicine, the first of its kind, correlating attention of scientists in dentistry, medicine, chemistry and biology on problems of dental research under the chairmanship of Dean Leroy M. S. Miner of the Harvard Dental School. Dean Miner has been prominent, within the university and in national professional associations, as an advocate of closer integration of the professions of dentistry and medicine.

It is planned to limit admissions to the new School of Dental Medicine to a small number of highly qualified men, who will be prepared for certain particular opportunities in the dental field: in teaching, research, special types of practice, general practice and public health. For example, it was explained, men will be equipped to attack the manifold problems of dental medicine in private practice as clinical specialists of particularly broad training, or to teach the science of dentistry in dental schools, or to investigate and treat dental disease in hospitals and clinics.

Certain important changes of method in dental education will be involved, bringing dental education at Harvard closer in line with the methods and standards of medical training. The plan envisages the development, in hospital and other dental clinics, of opportunities for training after graduation. It is anticipated also that a number of teaching and research fellowships will be established. As in the Medical School, there will be left to postgraduate experience some of the preparation for complete technical proficiency in specialized fields. The program will result also in closer integration of teaching, research and clinical work in dentistry at Harvard.

By bringing dental and medical students together in the basic preclinical and clinical subjects, it is expected that not only will the educational opportunities of the dental student be advanced, but also that there will follow modifications in the teaching of medical students, bringing to them important knowledge of oral medicine and oral disease now lacking in their training.

Dr. Conant said:

> This idea is not new to dentistry or to Harvard; for years the teaching staff of the Harvard Dental School, under the leadership of Dean Miner, has been stressing the close and essential relationships between dentistry and medicine. The new plan is to be regarded as an extension of developments al-

ready under way in the Harvard Dental School. It is believed that it will develop both theory and practice in the profession and make dentistry more significant and more important than ever before.

Plans for the School of Dental Medicine have been developed through many months of study by a committee of medical and dental educators. This committee was as follows: C. Sidney Burwell, M.D., Research Professor of Clinical Medicine and Dean of the Faculty of Medicine; Percy R. Howe, D.D.S., Thomas Alexander Forsyth Professor of Dental Science and Instructor in Pathology; Leroy M. S. Miner, D.M.D., M.D., Professor of Clinical Oral Surgery and Dean of the Dental School; Harold C. Stuart, M.D., Assistant Professor of Pediatrics and Child Hygiene; Kurt H. Thoma, D.M.D., Charles A. Brackett Professor of Oral Pathology; Lewis H. Weed, M.D., Professor of Anatomy and Director of the Department of Anatomy and Director of the School of Medicine, Johns Hopkins University; George B. Wislocki, M.D., Parkman Professor of Anatomy; and S. Burt Wolbach, M.D., Shattuck Professor of Pathological Anatomy.

U. S. PHARMACOPOEIA

THE Pharmacopoeial Convention of 1940, held in Washington, D. C., May 14 and 15, was undoubtedly the most important meeting of this convention since its founding in 1820.

With the advent of the new Federal laws on foods, drugs and cosmetics and with the increasing tempo of research in the fields of therapeutics and pharmaceutical chemistry, the responsibilities of those charged with the revision of the Pharmacopoeia have increased tremendously.

It is apparent that future revisions of the Pharmacopoeia, a legal standard, will involve not only scientific work of a high order, but also the development of machinery competent to deal with problems of ever-increasing complexity.

The dental profession has an interest in the development of a useful and adequate United States Pharmacopoeia. Indeed, as a healing profession, it has a duty to perform in the development of a work so important in the treatment of human ailments, including those which are primarily our concern.

Up to the present time, the dental profession has had no representation on the important Committee of Revision of the United States Pharmacopoeia. At the Washington convention, Thomas J. Hill, of Cleveland, was elected a member of that important committee. We are progressing.

FREDERICK B. NOYES TO BE HONORED

FREDERICK B. NOYES, retiring dean of the University of Illinois, College of Dentistry, September 1, will be honored at a testimonial banquet on the evening of September 14. Because of the prominence of Dr. Noyes in organized dentistry, dental education and dental research, this occasion promises to be outstanding. The banquet, which is sponsored by the faculty of the University of Illinois, College of Dentistry, will be held at the Lake Shore Athletic Club, Chicago, the Saturday following the American Dental Association meeting in

Cleveland (September 14). This date was chosen to make it possible for those attending the A.D.A. meeting to come to Chicago to join in honoring Dr. Noyes. For further information or reservations, address Allan G. Brodie or Stanley W. Tylman, 808 South Wood St., Chicago.

AMERICAN DENTAL ASSOCIATION STANDARDS FOR DENTAL PAPERS

PAPERS to be acceptable for presentation before the Scientific Sections of the American Dental Association, and thus for publication in THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION, should (1) contain and establish new facts, describe new modes of practice or set forth principles of real value; (2) embody the results of well-advised, original research, or (3) present so complete a review of the facts concerning any particular subject as to enable the reader to deduce therefrom legitimate, important conclusions.

SUGGESTED OUTLINE OF FORM FOR PRESENTATION

1. Title (subject). The title should clearly indicate the subject, the theme of the paper.
2. Introduction. Historical data. Statement of subject or problem. Review of pertinent literature.
3. Presentation of original data. Methods and materials used.
4. Discussion of data (facts and views) in connection with the literature.
5. Summary: A concise statement of the definite purpose of the paper and the main facts presented.
6. Conclusions: Statement of findings based on the data in the article.
7. Bibliography: Source of reference reading.

OUTLINE OF FORM FOR CASE REPORTS

1. History, giving name, sex, age, nature of complaint, previous illness and family data.
2. Examination.
3. Diagnosis.
4. Treatment.
5. Results.
6. Comment.

SUGGESTIONS TO DENTAL WRITERS

A paper read before a dental society becomes the property of that society. The author, therefore, has not the privilege (without the consent of the society) of publication of the paper.

Manuscripts

Manuscripts should be typed, double spaced, and written on one side of the paper and the pages should be numbered.

The original, not a carbon copy, should go to the editor.

The title should be descriptive but brief.

Degrees and city should follow the name of the author, and the street address should be given at the end of the paper.

If the paper was read before a society, a footnote should give this information, with the name of the society and the date and place read.

Bibliographic references should be listed at the end of the paper, giving name, including initials, of authors, with title of paper, and source, including volume, page, month and year. In the case of books, the author, title, publisher, edition and year should be given.

The use of trade names of products and appliances should be avoided when possible.

Spelling of proper names should be carefully verified.

Obscure abbreviations and unfamiliar symbols should be avoided.

Subheads (division headings) are desirable in a paper of considerable length.

A summary of the findings, and the conclusions of the author based on the findings, are desirable at the close of an article.

Illustrations and Tables

Illustrations (glossy print photographs, preferably) should accompany the manuscript. The illustrations should be numbered consecutively in the order in which they are to appear, and each should bear the author's name. Each illustration should be accompanied by a descriptive legend and should be referred to at the proper place in the text.

Drawings and charts should be made on cardboard with india ink. Chart paper should have a background of black lines if the background is to be retained. Blue lines in the background disappear in reproduction of a chart.

Tables or tabulations should be numbered and each should be given a heading and be referred to by number at the proper place in the text.

Editorial alterations will be made in order that the article may conform to THE JOURNAL style.

The Standard Dictionary is the guide for academic terms and Dorland's American Illustrated Medical Dictionary for medical and anatomic terms.

CORRESPONDENCE

"WHY NOT SAVE THE PULP INVOLVED TOOTH?"

To the Editor:

Replying to your editorial in the May JOURNAL: In fairness to William Hunter and to the readers of THE JOURNAL, I feel impelled to ask you to revise your statements regarding him. William Hunter is not a dentist—he is a physician—M. D., Edinburgh, and F. R. C. P., London. In his address given at McGill University, October 3, 1910, and published in the *Lancet* for January 1911, he says, "It was while seeking to throw light on the origin and meaning of a piece of blood pigment present in an organ in the first case I ever examined for curiosity's sake, that I stumbled upon the chief subject and interest of my life's work, namely that of anemia. And it was while observing as fully as I could all the features of the first case of anemia which I ever studied clinically that I came upon the curious facts that ultimately led me to recognize the importance of sepsis in medicine, not only in producing anemia, but also many other medical affections."

It was well for the profession that Hunter called a halt to the practice "by over-enthusiastic dentists" of subordinating the "biological principles" of dentistry to those of "mechanics." I disagree with you when you say "Hunter's revelations swung the pendulum as far or farther in the direction of removal of all these teeth that had been sacrificed for abutments, and as many others as might be even suspected of being the cause of oral focal infection," because the root-canal therapy of that day was no more scientific than that of today.

"The efforts of dental research workers who had been at work assiduously to devise ways and methods that would assure a sane procedure for restoring pulp involved teeth were finally rewarded with success, and today the fact that the pulp involved tooth can be restored to usefulness, and without menace to the health of the patient, has been indubitably established. The vital principle involved in all the procedures that have proved successful has been the well-known cardinal principle upon which successful surgery is based—asepsis." Your statement is scientifically unacceptable because the well-known cardinal principles of surgery of which you speak are based on the cardinal surgical principle of physiologic resolution. A dead (pulpless) tooth is devoid of all such physiologic power.

That, as you state, "a tooth in which the pulp has become involved is not necessarily a 'dead' one" does not change the fact that such a tooth has had its normal physiology permanently destroyed by the removal of its pulp. The dentin in such a tooth is dead; the cementum becomes hypercementosed; the pulp which gave life to the tooth is gone. What else can a tooth be but dead when all its living parts have become moribund?

You state, "In our present issue, we present one of the most exhaustive and scientifically

sound studies of the problem that have thus far been presented, the paper by Drs. Sommer and Crowley, which should dissipate finally all doubt as to the ability of the dental operator to save the pulp involved tooth." In his paper "Recognition, Interpretation and Management of Periapical Bone Lesions in Dental Health Service," published in THE JOURNAL in April 1938, Sommer makes the statement that: "Periapical bone involvement is generally found to be far more extensive at the time of resection than the roentgenogram would seem to indicate. For this reason, in preparation for a root resection, it frequently becomes necessary to devitalize one or two healthy adjacent teeth whose apices closely approximate the involved area. Unless this precaution is taken, the entire case may prove to be a failure, owing to interference in the blood supply of the vital teeth at the time of curettement." There is not a lay patient who would consciously permit any dentist to devitalize one or more healthy teeth to make an unscientific root resection operation apparently successful.

You say: "Rhein, Callahan, Grieves, Coolidge, Prinz, Walker, Howe, Rickert, Johnston, Hatton, Blayney, Waas, Grossman and numerous other root-canal workers have demonstrated the fact that beyond a doubt a tooth in which the pulp has become involved is not necessarily a 'dead' one." When the living component parts of a tooth have been destroyed, either pathologically or artificially, the tooth must necessarily be moribund.

The research work of Rosenow, Haden, Price, Novitzky and others has demonstrated the opposite findings of Rhein, Callahan and the others that you mention. I am confident that the members of the American Society of Exodontists will also agree with Rosenow, Price, Haden and Novitzky as to the results of their research work.

Your conclusion that it has been indubitably established that the pulp involved tooth is not a menace to the health of the patient is pure prejudice on your part and on the part of the root-canal therapists.

Your five points as to whether a pulpless tooth should be retained or extracted seem to boil down to the fact that you are fearful that the majority of the dental practitioners in the country have not been sufficiently trained to do work of this kind. 1. If the judgment of the operator is such an important factor in the selection of the teeth in which the procedure should be attempted, you admit, then, that there are many pulpless teeth on which treatment should not be attempted. Why? 2. Since our state boards have licensed the dental practitioners of the country, the statement would not look well in public print that our profession's representative journal questions the present ability of operators to meet the demands of such a dental operation. 3. If it has been *indubitably* established that pulp involved teeth are not a menace to the health of the patient, why do you limit the application of the operation of root-canal therapy to the age and health of the patient? 4 and 5. How can the patient have an appreciation of this "effort," when he has no idea what the operation is about? And, as Sommer says, "when a tooth has been removed, it ceases to be a potential candidate for any form of operative dentistry."

In closing, I am at a loss to understand why the editorial board of THE JOURNAL refuses to publish the opposing side of the root-canal therapy problem, and yet allows the Editor of THE JOURNAL, who should be impartial on all subjects, to express his opinions in this, so far, one-sided discussion.

H. A. TUCKEY, D.D.S.,
450 Sutter St.,
San Francisco, Calif.

OBITUARY

JAMES EDWARD CHACE, D.D.S.

(1875-1940)

JAMES EDWARD CHACE was born in Key West, Fla., January 9, 1875. His father, James Chace, was a pioneer dentist beloved as one of the founders of the Florida State Dental Society.

Upon completing his high school education, Dr. Chace entered the University of Pennsylvania Dental School, from

J. E. Chace

which he was graduated in 1896. After practicing several years in Pulaski, Tenn., he moved, in 1899, to Ocala, Fla. There he practiced until last December, when he was stricken with undulant fever, from which he died in a Jacksonville hospital, April 29.

Dr. Chace was a member of the Central District Dental Society, the Florida State Dental Society and the American Dental Association. He was a Fellow of the American College of Dentists and a member of Omicron Kappa Upsilon, honorary dental fraternity, and of the Southern Academy of Periodontology. The Good Fellow degree was conferred on him by the state dental society, and he was the recipient of a certificate of honor awarded by the Central District Society. He served as president of the following organizations: the original Southern Branch of the National Dental Association; Florida State Dental Society and the Central District and Marion County Dental Societies; and he was at one time a member of the state board of dental examiners.

Dr. Chace possessed an unusual sense of civic responsibility, having been mayor of Ocala and the first president of the Ocala Rotary Club. He was also active in the business affairs of his city. He served for years as president of the Ocala Community Hotel Company, which owns and operates the Marion Hotel. Active also in fraternal organizations, he was Past Worshipful Master of the Masonic Lodge and a member of the Morocco Temple Shrine.

Among his colleagues in the profession, Dr. Chace was known and respected far and wide for his knowledge, his skill and his unusual personal qualities. All who knew him admired his alert, inquiring mind, his learning, his judgment and his craftsmanship. He was a gentleman of integrity, versatility and charm, with an unusual capacity for friendship. As a dentist, he exemplified the highest ideals of dentistry and he will long be missed both in and outside the profession. One of his sons, Richard Chace, of Ocala, "carries on" as a third generation "Dr. Chace."

C. J. CARABALLO.

IDENTIFICATION AID

In an official investigation which is being conducted by the Police Department of the City of Burlington, Vt., efforts are being made to identify the body of an unknown white man found in Lake Champlain.

Herewith is submitted a photograph of the bridgework which was taken from the mouth of the deceased, in the hope that the dentist who did this work may be found. Enclosed also is a list of the remaining teeth.

Arthur Thalacker,
Chief of Police,
Burlington, Vt.

Description of teeth by Dr. Lavalley, D.M.D.

Upper right:
Third molar present.
Second permanent molar present.
First permanent molar present.
Second bicuspid extracted some time ago (years).
First bicuspid in place.
Cuspid in place.
Open face crown on right lateral with bridge attachment to right central and left lateral incisors.

Upper left:
Cuspid present.
Bridge attached to permanent upper first bicuspid.
Second bicuspid missing.
First molar missing.
Second permanent molar present.
Third molar present.

Lower right:
Third molar present.
Second permanent molar present.
First permanent molar missing.
First and second bicuspids present.
Cuspid present.
Lateral incisor present.

Central incisor present.

Lower left:
Central incisor present.
Lateral incisor present.
Cuspid present.
First bicuspid present.
Second bicuspid missing.
First permanent molar missing.
Second permanent molar missing.
Third molar present.

DEATHS

Anderson, N. C., Ft. Morgan, Colo.; died recently.

Brandstater, C. Albert, Los Angeles, Calif.; College of Physicians and Surgeons, A School of Dentistry, 1916; died April 14; aged 66.

Burton, Isaac, Colorado Springs, Colo.; Northwestern University, 1895; died March 20.

Dodge, Charles F., Denver, Colo.; Boston Dental College; died March 15; aged 81.

Gibbs, S. M., Ft. Collins, Colo.; Chicago College of Dentistry, 1906; died April 17.

Hinkle, T. A., Colorado Springs, Colo.; University of Denver, School of Dentistry, 1925; died June 4, 1939.

Moss, J. M., Homestead, Pa.; University of Pittsburgh, School of Dentistry, 1913; died March 8; aged 56.

Mulford, Warren E., Denver, Colo.; Denver University School of Dentistry, 1916; died May 7; aged 49.

CURRENT LITERATURE

Indian Dental Service

By Raymond Mundt and Harvey E. McDowell

In contrast to the period prior to 1873, when "medicine men" provided the only dental service available to the Indian, today there is a dental service organized under the Director of Health, Office of Indian Affairs. There is a supervising dentist under the U. S. Public Health Service and fifteen full-time traveling dentists; also two full-time and eleven part-time dentists serving, for the most part, in hospitals.

At present, there are twelve dental areas in the western and north central United States, plus one in Alaska. The areas vary in size, but each contains about 15,000 Indians, who are served by a traveling dentist with portable equipment. Most of the work is done for day and boarding school pupils, numbering about 150,000. Adult Indians may visit the dentist while he is at the schools. Each school is visited about once a year.

The dentist's work consists mainly of examinations, extractions, amalgam fillings, treatments for Vincent's infection and instruction regarding dental hygiene to the teachers and nurses. Dental caries in the schools varies from 20 to 30 per cent for some tribes to from 60 to 70 per cent for others. The authors have noted that the meat-eating Navajo and Apache have the lower rates, while the carbohydrates eating Hopi and Pueblo have the higher rates. Mottled enamel is prevalent among many of the southwestern Indians. The Navajo tribal council supports a full-time dentist on a non-profit basis at their new hospital at Fort Defiance, Ariz.—*Mil. Surgeon,* **86**:348, April 1940.

S. B. Finn.

Die Disinfektion Zahnarztlicher Instrumente mit Zephirol (The Disinfection of Dental Instruments with Zephirol)

By Annelise Winkler and Kurt Redecker

The ability of zephirol to disinfect dental instruments was tested. Five-tenths per cent and 1 per cent solutions sterilized instruments in fifteen and ten minutes, respectively. Metal instruments allowed to remain in a solution of zephirol and 0.5 per cent sodium nitrite for eight weeks showed no rusting. The addition of sodium nitrite did not decrease the disinfecting power of the solution. A 5 per cent solution of zephirol in 50 per cent glycerin was found to be an economical, practical and efficient disinfectant and lubricant for hand and angle pieces.—*Zentralbl. F. Bakt.,* **145**:72, November 1939.

Hazel Tefft.

Physical Measurements on Negro, Navajo and White Girls of College Age

By Morris Steggerda

In carrying out measurements on Negro, Navajo and white girls, 100 each, the author examined the teeth. Conspicuous differences in caries susceptibility were noted. The Navajos possessed decidedly better teeth than the Negroes, who, in turn, had better teeth than the whites. The figures given are low in that all examinations were carried out without distal instruments, the cavities recorded being only those visible with the aid of a tongue depressor. However, since all examinations were carried out in the same manner, the figures given have comparable relative value.—*Am. J. Phys. Anthropol.,* **26**:417, March 1940.

B. P. Kearney.

Local Anesthesia: Its Application in Operative Dentistry

By Glenn W. Berry

The application of local anesthetics has been so simplified that we are now able to prepare cavities in all teeth without the resultant harmful psychologic experiences occasioned by actual pain. Gentleness in syringe manipulation and handling of anesthetized tissue is especially important.

There should be no hesitancy about blocking both right and left mandibular nerves. In the author's experience, the infra-orbital

injection has been very successful, with seldom any untoward sequelae. If numerous maxillary teeth are involved in the cavity preparation, profound anesthesia will be induced by means of two injections, the infra-orbital and the tuberosity. In almost all cases, the tuberosity injection will anesthetize the first as well as the second and the third molar.

In a series of cases involving approximately eighty-six injections, there have been very few cases of toxic reaction; postoperative pain caused by injection, or tenderness.

Arguments presented against the use of local anesthesia for cavity preparation are for the most part unfounded. If the operator is so careless as to place dental prostheses directly upon exposed pulps or so foolish as to not respect tissues upon which he is operating, anesthesia should not be used.—*U. S. Nav. M. Bull.*, 38:249, April 1940.

ARTHUR F. FISHER.

Dental Abnormalities in Recruits

By WALTER REHRAUER and KARL VAN LEAR BERGLUND

THREE hundred and fifty-nine recruits for the U.S.S. *Saratoga* were examined and findings recorded over a fifteen-month period. Both clinical and roentgenographic examinations were made of all recruits.

The recruits examined represented a cross-section of this country because they were picked up from five different training stations. The average age of these men was the susceptible age, wherein dental caries progresses very rapidly (19 years, 10 months).

It was found that in the 359 young men, there were 11 carious areas (average) per man when they enlisted. After training base dental care, these 359 men, after reporting for sea duty aboard the U.S.S. *Saratoga*, averaged $7\frac{3}{4}$ carious areas per man. Most of the progressive carious areas which existed when these men were enlisted could not have been detected by medical department personnel at the recruiting offices with the means available to them for making an examination of teeth and mouth.

Also detected were overhanging approximal filling margins in 139 teeth of eighty-seven recruits of the 359 total men. Recruits often requested relief from pain caused by overhanging fillings. These large masses of overhanging filling material caused severe gingivitis, hypertrophy of gingival gum tissue, destruction of interproximal bone and tissue crests, rapid resorption of alveolar process, pockets, caries, general oral unsanitary condition and Vincent's infection.

Of the 359 recruits, forty had thirty-two serviceable (not caries-free) teeth and 260 had twenty-eight or more serviceable teeth.—*U. S. Nav. M. Bull.*, 38:242, April 1940.

ARTHUR F. FISHER.

Elimination of Oral Sepsis

By C. W. SCHANTZ

THE etiology of paradentosis is unknown. Accepted theories are based on both local and systemic conditions. The most important etiologic factors in successful bacterial invasion include (a) malrelation of teeth and supporting structures; (b) abnormal character and flow of saliva; (c) dietary deficiency, and (d) lack of proper oral hygiene.

A case report is given as evidence that early treatment and subsequent hygiene measures will have lasting effects in correcting paradentosis.

Gum resection is discussed and the means of operating for such a procedure. There are several ways of controlling deep pockets, but of all the operative procedures, gum resection is the most certain. The only objection urged against gum resection is that it is disfiguring. This disfigurement is less than would be expected, because the gums slowly grow to one-half their former level.—*U. S. Nav. M. Bull.*, 38:246, April 1940.

ARTHUR F. FISHER.

Natural Occurrence of Zinc in the Teeth

By D. B. CRUIKSHANK

Two series of teeth were analyzed to determine the amount of zinc found in normal teeth and in teeth from tuberculous persons. In the second series of tests, the technic (Sylvester and Hughes) was greatly simplified and improved. The two series combined showed that in an analysis of 231 teeth from twenty-two normal and nineteen tuberculous persons, the zinc level of the dentin increased 7.3 per cent and of the enamel, 17.1 per cent, in the tuberculous. In addition, analyses showed that the zinc content (averaging 178 ± 2 for dentin and 152 ± 27 mg. per kilogram for enamel in normal teeth) varied from tooth to tooth, being highest for

the molars and gradually decreasing toward the anterior teeth. This finding suggests that the zinc content increase coincides with the period of calcification in the tooth. Moreover, since the zinc content begins to increase in youth, it is initiated before the clinical manifestations of tuberculosis.—*Brit. Dent. J.*, 7:257, April 1940.

ANNE MORRIS.

Harelip and Cleft Palate

By K. B. FRAZER

IN a review of the history, embryology, clinical manifestations, detailed operative procedures and postoperative care, the author has given a complete picture of the anomalies of cleft palate and harelip. He concludes, from his experience, that the success of the operation depends not only on the skill of the surgeon and his complete knowledge of all the details given in the review, but also on the close collaboration of the surgeon, the physician, specially trained nurses, the dentist and the speech expert. He especially emphasizes the important part that the dentist and speech expert play in improving the appearance and elocution of the patient.—*Med. J. Australia*, 11:361, March 1940.

An Unfamiliar Cause of Loss of Weight

By WILLIAM A. PUSEY, M.D.

EARLY in 1937, the author became conscious of the fact that he had almost lost his taste for food. The condition became so marked that he lost 20 pounds in four months. Thorough study revealed no cause for the loss of weight. After some time, it occurred to him that the deterioration in taste was the result of wearing a dental plate which covered most of the hard palate. It was discovered that when the plate was out, the taste was normal. With the plate in, a piece of beefsteak had no more flavor than a ball of cotton, but when the plate was removed, the same mouthful would instantly taste normal. In the belief that the vulcanite in the denture might be a factor in the condition, a new plate of vitallium was made, but the effect on the sense of taste remained the same. Finally, a cast upper denture of vitallium with a thin palatal bar was made, leaving most of the hard palate uncovered. Since that time, there has been a return to normal weight, and although food has not entirely regained its flavor, it is sufficiently palatable to encourage one to eat. No facts evolved from the study suggesting that the composition of the denture had anything to do with the loss of the sense of taste. It seemed to be purely a matter of the area of the palate covered by the denture.—*J.A.M.A.*, 114:1548, April 20, 1940.

M. K. HINE.

Action of Gastric and Salivary Mucin on Phagocytosis

By RUTH TUNNICLIFF

In vitro experiments show that gastric and salivary mucin (saline solution of lactic acid precipitate from saliva) produce a covering on staphylococci and *Streptococcus viridans* which prevents their staining vitally and inhibits their phagocytosis. *In vivo* experiments on mice show that mucin-coated staphylococci are not taken up by leukocytes for two hours following injection. The organisms then multiply so rapidly that they kill mice in twenty-four hours. In control animals, phagocytosis occurs in one hour, and the mice recover. Only cocci uncoated with mucin are taken up by leukocytes.—*J. Infect. Dis.*, 66:189, March-April 1940.

HAZEL TEFFT.

The Therapy of Fusospirochetosis

By HENRY FIELD, JR., M.D.

FUSOSPIROCHETOSIS, or Vincent's infection, infection by a symbiotic group of anaerobic organisms commonly present around the teeth, has not received adequate attention from the medical profession. Much remains to be proved regarding the treatment of fusospirochetal infections; for although numerous drugs have been reported to give favorable results, carefully controlled studies have not been made. Probably more attention should be paid to the general treatment and, when the gums are involved, dental measures. Certain blood diseases, such as acute leukemia, aleukemic leukemia, aplastic anemia, granulocytopenia and infectious mononucleosis, are peculiarly apt to be complicated by Vincent's infection. Poisoning from heavy metals, acute infectious, chronic debilitating diseases and decreased vitamin intake may predispose to Vincent's infection. Consideration of these predisposing factors is essential before satisfactory treatment can be anticipated.

Oral fusospirochetosis presents problems in prophylaxis and treatment for both physician and dentist. These are important, not only intrinsically, but also for the prevention of secondary infections. The author discusses several local treatments and recommends the following plan: The patient should be seen one or more times a day while the infection is acute. She should use a mouthwash of hydrogen peroxide diluted with an equal volume of hot water, potassium permanaganate 1:1,000 or sodium perborate every two hours while awake. When the infection has subsided, the indicated periodontal and dental work may be started. Mouthwashes should be continued three times a day for weeks after apparent healing. Local chemotherapy for fusospirochetal infections elsewhere may follow a similar plan, adapted to technical requirements. It appears that the injection of arsenicals in the presence of lesions not accessible to local treatment may be advised, provided it is not relied on to the neglect of other measures. For an adult weighing 150 pounds, the following dosage of neoarsphenamine is suggested: 0.3 gm. the first day and 0.45 the third and sixth days, with repetition of this dose at weekly intervals if necessary. Doses of approximately half these amounts have given good results. In the treatment of Vincent's infection, it is of primary importance to correct, if possible, conditions that permit organisms which are ordinarily harmless saprophytes to become invasive.—*J.A.M.A.*, 114:1073, March 23, 1940.

M. K. HINE.

Action de la Mucine sur le Mecanisme de L'Infection Action sur la Bacteriolyse

By GENESIO PACHECO and J. NORONHA PERES

MUCIN *in vitro* was proved to inhibit the bacteriolytic action of anticholera serum on the cholera vibrio. In a series of tests with adequate controls, the mucin was shown to give twenty-five colonies with a 1:100 dilution of the serum, while the plates containing no mucin were sterile, and, in the 1:1600 dilution, the mucin-containing plates showed 1,200 colonies, while those without mucin had only forty-five.

This experiment affords further confirmation of the work of Miller *(Science,* 78:340, 1933), who stated that mucin reinforces the virulence of pathogenic bacteria for laboratory animals. It also supplements the work of Keefer and Spink *(J. Clin. Invest.,* 17: 23, 1938), who showed that mucin reduced the bactericidal titer of antigonococcal serums.—*Compt. rend. soc. de biol.,* 133:337, 1940.

ANNE MORRIS.

Types of Tooth Mutilation Found in Mexico

By D. F. RUBIN DE LA BORBOLLA

TWENTY-FOUR types of tooth mutilation have been found in Mexico, consisting of three general types: filing, inlaying and filing-inlaying. All evidence points to the fact that no mutilation was carried out previous to adolescence or after death. Inlays were not used to restore a carious tooth, but solely as a means of decoration or to designate castes. Mutilations were restricted almost entirely to the upper anterior two, four or six teeth.

The inlays were of hematite or green stone. Gold or other materials, such as obsidian, were apparently not used in Mexico for this purpose. Although little is known of their means of cavity preparation, setting the inlay, etc., the work in general was of a high order.—*Am. J. Phys. Anthropol.,* 26: 349, March 1940.

B. P. KEARNEY.

Effect of Thyroparathyroidectomy at Birth and at Seven Days on Dental and Skeletal Development of Rats

By DANIEL E. ZISKIN, THEODORA N. SALMON and EDMUND APPLEBAUM

THYROPARATHYROIDECTOMY of rats at birth causes retardation of growth, defective ossification of epiphyses of the long bones, infantile skull proportions and general symptoms of human cretins, such as sluggishness and lack of muscular coordination. Reimplantation of the thyroparathyroids under the skin of control groups results in normal growth and behavior. Animals operated on at seven days exhibit less severe symptoms.

Dental findings in animals operated on during the first or second day include delayed eruption time, retardation of dentin and root formation and decrease in weight and rate of development of the mandible. The size of the crowns of the molar teeth is apparently not affected. Rats operated on

at seven days also exhibit changes in the dental apparatus of a similar, but less marked nature.—*J. D. Res.*, 19:93, February 1940.

B. P. KEARNEY.

Cancer of the Tongue in Young Subjects

By GEORGE W. SALEEBY

IN a case of squamous-cell epidermoid carcinoma of the tongue in a girl aged 15 years, the primary lesion disappeared under radium and roentgen therapy, but a cervical metastasis proved to be radioresistant. One year after the onset of symptoms, death occurred.

Eight cases of cancer of the tongue in subjects aged 20 years or less, and two in newborn infants have been collected from the literature and are included in the discussion. A table is made up of outstanding features of these cases. A few points worth noting are: First, in none is there evidence of mechanical irritation, such as is produced by defective teeth. Second, there is no mention of so-called precancerous conditions. Finally, none of the patients came from a "cancer family" or showed any indications of hereditary syphilis.—*Am. J. Cancer*, 38:257, February 1940.

ARTHUR F. FISHER.

Effect of Artificially Induced Fever on the Structure of the Developing Teeth of the Rat

By J. BEVELANDER and F. G. BERNSTEIN

RATS subjected to artificial fever develop hyperemia in the vessels of the dental pulp, a condition which is reversible and closely follows the temperature curve. In agreement with previous observations, the authors found defective dentin formation when fever was induced by short waves or a thermoregulated oven. It is interesting to note that the enamel appeared unaffected by the artificial fever.—*J. R. Res.*, 19:155, April 1940.

R. F. SOGNNAES.

Beitrag Zur Kenntnis der Speichelamylase (A Contribution to Our Knowledge of Salivary Amylase)

By H. NINOMIYA

VARIOUS experiments were attempted to show the effect of dialysis and salt concentration on amylase activity. Dialysis of saliva resulted in the retention of activity in the precipitate, but not in the filtrate. Fractional precipitate with ammonium sulfate concentrated the enzyme in the globulin fraction. No activity could be noted in the albumin portion. The salivary amylase was found to be best activated by 0.5 mm. of sodium chloride. The solubility of the enzyme is greatest at this concentration, and from this it would seem that the activation of the enzyme by the salt is controlled by enzyme solubility. The optimal pH for the amylase is 6 to 8, with a working range of pH 4-10. The iso-electric precipitate is approximately 4.0. Similar experiment showed that the enzyme taka diastase is not activated by sodium chloride or precipitated by dialysis. —*J. Biochem.*, 31:69, January 1940.

J. VOLKER.

Metastases from Carcinoma of the Tongue

By MAURICE D. SACHS

IN 147 cases of primary carcinoma, the ratio of male to female was 14:1. The average age was between 45 and 65 years. The mean average duration of symptoms before medical aid was sought was seven months. The range was from four days to thirty years. In four (9.7 per cent) of forty-one cases examined postmortem, there was distant metastasis; 5.4 per cent on a basis of eight out of 147 cases. In four additional cases, there was roentgen evidence of distant metastasis, in two to the lungs; in one to the sternum, and in one to a vertebra.—*Am. J. Roentgenol.*, 42:833, December 1939.

VIRGIL D. CHEYNE.

The pH of Carious and Non-Carious Dentin

By LOUIS I. GROSSMAN

pH determinations by means of the Beckman apparatus on 2 cc. samples of carious and non-carious dentin from recently extracted teeth revealed a significant difference (1.65 pH) among values for sound dentin (8.16 pH) and carious dentin (6.51 pH). There were insignificant differences (0.1 pH) between values of sound dentin taken from carious, sound or filled teeth.—*J. D. Res.*, 19:171, April 1940.

VIRGIL D. CHEYNE.

ANNOUNCEMENTS

ANNOUNCEMENTS must be received by the fifth day of the month in order to be published in the forthcoming issue of THE JOURNAL.

CALENDAR OF MEETINGS

ALPHA OMEGA FRATERNITY, Baltimore, Md., December 29-30.

AMERICAN ACADEMY OF PERIODONTOLOGY, Cleveland, Ohio, September 5-7.

AMERICAN ACADEMY OF RESTORATIVE DENTISTRY, Cleveland, Ohio, September 7-8.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF ORAL DIAGNOSIS, October 17-18, New York, N. Y.

AMERICAN ASSOCIATION OF DENTAL EDITORS, Cleveland, Ohio, September 7.

AMERICAN ASSOCIATION OF PUBLIC HEALTH DENTISTS, Cleveland, Ohio, September 8-10.

AMERICAN COLLEGE OF DENTISTS, Cleveland, Ohio, September 8.

AMERICAN CONGRESS OF PHYSICAL THERAPY, Cleveland, Ohio, September 2-6.

AMERICAN DENTAL ASSISTANTS ASSOCIATION, Cleveland, Ohio, September 9-12.

AMERICAN DENTAL ASSOCIATION, Cleveland, Ohio, September 9-13.

AMERICAN DENTAL HYGIENISTS' ASSOCIATION, Cleveland, Ohio, September 9-13.

AMERICAN PUBLIC HEALTH ASSOCIATION, Detroit, Mich., October 8-11.

AMERICAN SOCIETY FOR THE PROMOTION OF DENTISTRY FOR CHILDREN, Cleveland, Ohio, September 9.

AMERICAN SOCIETY OF ORAL SURGEONS AND EXODONTISTS, Cleveland, Ohio, September 6-7.

ASSOCIATION OF MILITARY SURGEONS OF THE UNITED STATES—DENTAL SECTION, Cleveland, Ohio, September 10.

DISTRICT OF COLUMBIA DENTAL SOCIETY, second and fourth Tuesdays in each month from October to June at the United States Public Health Service Auditorium, Washington.

GREATER NEW YORK DENTAL MEETING, Hotel Pennsylvania, New York, December 2-6.

INTERNATIONAL COLLEGE OF DENTISTS, Cleveland, Ohio, September 8.

NATIONAL ASSOCIATION OF DENTAL EXAMINERS, Cleveland, Ohio, September 7-8.

NATIONAL DENTAL ASSOCIATION, St. Louis, Mo., August 12-16.

ODONTOLOGICAL SOCIETY OF WESTERN PENNSYLVANIA, Pittsburgh, October 22-24.

PIERRE FAUCHARD ACADEMY, Cleveland, Ohio, September 9.

PSI OMEGA, Cleveland, Ohio, September 9-10.

DENTAL ALUMNI SOCIETY, University of Pennsylvania, Philadelphia, September 19.

WISCONSIN STATE DENTAL ECONOMIC STUDY CLUB, Madison, August 2-3.

STATE SOCIETIES

July

New Mexico, at Santa Fe (1-3)
Utah, at Salt Lake City
Wyoming, at Rock Springs

August

Hawaii, at Honolulu

October

Southern California, at Los Angeles

November

Florida, at St. Petersburg (11-13)
Ohio, at Cincinnati (25-27)

April (1941)

Massachusetts (14-17)

May (1941)

Illinois, at Peoria (12-15)

STATE BOARDS OF DENTAL EXAMINERS

Arizona, at Phoenix, July 10-13. R. A. McCall, 719 Professional Bldg., Phoenix, Secretary.

North Dakota, at Fargo, July 8-11. L. I. Gilbert, 401 Black Bldg., Fargo, Secretary.

ALPHA OMEGA FRATERNITY

THE annual convention of the Alpha Omega Fraternity will be held at the Belvedere Hotel, Baltimore, Md., December 29-30.

EMANUEL HOFFMAN, *Publicity Manager,*
827 West 36th St.,
Baltimore, Md.

AMERICAN ASSOCIATION OF DENTAL EDITORS

THE American Association of Dental Editors will hold its annual meeting in the Statler Hotel, Cleveland, Ohio, Saturday, September 7. An all-day program has been arranged and editors are urged to attend.

O. W. BRANDHORST, *Secretary,*
4952 Maryland Ave.,
St. Louis, Mo.

AMERICAN ASSOCIATION OF PUBLIC HEALTH DENTISTS

THE annual meeting of the American Association of Public Health Dentists will be held in the Rose Room, Hotel Cleveland, Cleveland, Ohio, September 8-10.

F. C. CADY, *Secretary,*
U. S. Public Health Service,
Washington, D. C.

AMERICAN COLLEGE OF DENTISTS

THE Cleveland convocation of the American College of Dentists will be held in the Statler Hotel, Sunday, September 8. There will be morning, luncheon, afternoon and evening sessions.

O. W. BRANDHORST, *Secretary,*
4952 Maryland Ave.,
St. Louis, Mo.

AMERICAN CONGRESS OF PHYSICAL THERAPY

THE nineteenth annual scientific and clinical session of the American Congress of Physical Therapy will be held September 2-6 at the Hotel Statler, Cleveland, Ohio. The annual instruction course in physical therapy will be given in the mornings and the scientific sessions will be held in the afternoons and evenings.

A. R. HOLLENDER, *Executive Director,*
30 North Michigan Ave.,
Chicago, Ill.

ASSOCIATION OF MILITARY SURGEONS OF THE UNITED STATES—DENTAL SECTION

A DINNER meeting of the Dental Section of the Association of Military Surgeons of the United States will be held in conjunction with the annual meeting of the American Dental Association September 10 at 6:30 p.m., Statler Hotel, Cleveland, Ohio. Delegates and representatives of all services will be present. Captain Conrad C. Gilkinson, Cleveland, is chairman of the dinner committee.

JOHN H. FREDERICK,
Major, DC, Maryland National Guard,
7 Elmhurst Road,
Baltimore, Md.

INTERNATIONAL COLLEGE OF DENTISTS

THE Mid-Year Meeting of the International College of Dentists (U. S. A. Section) will be held in the Salle Modern, Hotel Statler, Cleveland, Ohio, Sunday, September 8, at 6 p.m.

ELMER S. BEST, *Registrar,*
801 Medical Arts Bldg.,
Minneapolis, Minn.

NATIONAL ASSOCIATION OF DENTAL EXAMINERS

THE annual meeting of the National Association of Dental Examiners will be held in Cleveland, September 7-8.

R. P. THOMAS, *Secretary,*
Heyburn Building,
Louisville, Ky.

NATIONAL DENTAL ASSOCIATION

THE National Dental Association will hold its twenty-seventh convention, August 12-16 in St. Louis, through the cooperation of the local chapter, the Mound City Dental Society. For further information, address

J. A. JACKSON, *Secretary,*
406 Commerce St.,
Charlottesville, Va.

ODONTOLOGICAL SOCIETY OF WESTERN PENNSYLVANIA

THE Annual Fall Convention of the Odontological Society of Western Pennsylvania

will be held in Pittsburgh at the William Penn Hotel, October 22-24.

JAMES M. MCNERNEY, *Secretary,*
8127 Jenkins Arcade,
Pittsburgh.

PIERRE FAUCHARD ACADEMY

A MEETING of the Pierre Fauchard Academy will be held Monday, September 9 in Parlor C, Hotel Statler, Cleveland, Ohio.

ELMER S. BEST, *Secretary,*
801 Medical Arts Bldg.,
Minneapolis, Minn.

PSI OMEGA

ALL Psi Omegas attending the Eighty-Second Annual Session of the American Dental Association are invited to the dinner dance of the fraternity at the Hotel Cleveland, September 9 at 6:30. Headquarters will be at the Cleveland Hotel and members are asked to register during the session. The business meeting will be held September 10 at 10 p.m. at fraternity headquarters.

JAMES H. FERGUSON, JR.,
Grand Master, National Alumni Chapter,
Medical Arts Building,
Baltimore, Md.

OHIO STATE DENTAL SOCIETY

THE next meeting of the Ohio State Dental Society will be held at the Netherland Plaza Hotel, Cincinnati, November 25-27.

VAN B. DALTON, *President,*
116 Garfield Place,
Cincinnati.

MASSACHUSETTS DENTAL SOCIETY

(Change of Date)

THE Massachusetts Dental Society will meet April 14-17, 1941.

PHILIP E. ADAMS,
106 Marlboro St.,
Boston.

ILLINOIS STATE DENTAL SOCIETY

THE next annual meeting of the Illinois State Dental Society will be held in Peoria, May 12-15, 1941. The newly elected officers are: John J. Donelan, Springfield, president; J. R. Blayney, Chicago, president elect; J. Leslie Lambert, Springfield, vice president; L. H. Jacob, Peoria, secretary, and R. W. McNulty, Chicago, treasurer.

L. H. JACOB, *Secretary,*
Jefferson Building,
Peoria.

AMERICAN DENTAL HYGIENISTS' ASSOCIATION

THE next annual meeting of the American Dental Hygienists' Association will be held in Cleveland, Ohio, September 9-13, with headquarters at the Hotel Carter.

A. REBEKAH FISK, *Secretary,*
Walter Reed Gen. Hospital,
Washington, D. C.

EXAMINATION FOR APPOINTMENT IN THE DENTAL CORPS, REGULAR ARMY

AN examination for the selection of candidates for appointment in the Dental Corps, Regular Army, will be held during the period July 15-20. The examination, which will include both physical and professional examinations, the latter consisting of written, oral and clinical tests, is open to male citizens of the United States who will be not over 32 years of age at the time it will be possible to render a commission, who are graduates of acceptable dental schools and who have had at least two years subsequent practice in their profession at the time of appointment.

Candidates who fail on the first examination will not be permitted to take more than one subsequent examination.

Full information and application blanks will be furnished on request to the Adjutant General, War Department, Washington, D. C. Applications will not be considered after June 29.

EXAMINATION FOR APPOINTMENT IN THE DENTAL CORPS OF THE NAVY

A COMPETITIVE examination to select not more than twenty for appointment in the Dental Corps of the Navy will be held July 8 at the Naval Medical School, Washington, D. C.; Naval Training Station, Great Lakes, Ill., and Naval Training Station, San Diego, Calif. A candidate for appointment in the Dental Corps must be a citizen of the United States, between 21 and 32 years of age at the time of appointment and a graduate of a

standard dental college. A circular which contains full information relative to the Dental Corps and describes the method of making application for appointment can be obtained from the Bureau of Medicine and Surgery, Navy Department, Washington, D. C.

PUBLICATION AND SALE OF THE PROCEEDINGS OF THE DENTAL CENTENARY CELEBRATION HELD AT BALTIMORE, MD., MARCH 18, 19, 20, 1940

A COMPLETE report of the transactions of the Dental Centenary will be printed in book form, approximately 800 pages, 400 cuts attractively arranged and carefully edited, indexed and ready for use. A record of this important event in dental history will be one of the most valuable features of the future library. The Centenary Committee has arranged for the sale of the proceedings, subject to future delivery. In order to encourage wide distribution of the text, it is offered at $5 a copy.

Send subscriptions to

EARL W. SWINEHART, *Chairman,*
Publicity Committee,
Medical Arts Bldg.,
Baltimore, Md.

UNITED STATES PATENTS APPLICABLE OR PERTAINING TO DENTISTRY ISSUED DURING MAY 1940

May 7

No. 2,199,479, JACK T. CAPPEL. Anesthesia pillow.

No. 2,199,877, JOSE CERVERA. Receptacle for tooth paste.

No. 2,199,922, ELBERT ARMSTRONG MCMANIS and WALTER SCOTT UHLER. Toothbrush.

No. 2,200,058, EDWARD L. CHOTT. Articulator.

No. D-120,382, CHARLES G. KERR. Design for a toothbrush.

May 14

No. 2,200,321, ROBERT C. ANGELL. Pulp tester.

No. 2,200,621, ALBERT W. HILLER. Dental controller.

No. 2,201,098, ORVILLE E. MCKIM. Preparation for cleaning removable dentures.

May 21

No. 2,201,190, CONRAD D. MASTRUD. Dental device.

No. 2,201,331, ALFRED G. WRIGHT. Mouth prop and light carrier.

No. 2,201,428, EDWARD L. CHOTT. Dental amalgamator.

May 28

No. 2,202,299, LOUIS N. PELKEY. Dental polishing machine.

No. 2,202,473, ARCHIE P. VICKERS. Dental casting machine.

No. 2,202,577, LOUIS W. EVANS. Dental impression mold.

No. 2,202,712, SIMON MYERSON. Artificial tooth.

No. 2,202,713, SIMON MYERSON. Artificial tooth.